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# ADULT TESTS OF THE STANFORD REVISION APPLIED TO COLLEGE STUDENTS

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SINCE the launching of investigations regarding intelligence tests and college students by Cattell (1), in 1896, a number of such studies have been made. Many of these were on freshmen only, and not all of them bear directly upon the present undertaking. Only those in which a comparison is instituted between results obtained from the tests and college standing as shown by grades, or estimated intelligence, will be mentioned here.

Wissler (2), discussing Cattell's results reports the following correlations of performance in the tests with University grades:—

| | |
|---|---|
| Reaction time | -.02 |
| Marking A's— | -.09 |
| Association— | .08 |
| Color naming— | .02 |
| Logical memory— | .19 |
| Auditory memory (position) | .16 |

It will be seen that the average correlation of the tests used with college grades was .09, which is so low as to be negligible and apparently justifies the conclusion that, "while the marks of students" (in different subjects) "correlate with each other to a considerable degree, they show little tendency to do so with the mental tests of the psychologist."

Calfee (3), using "Four General Intelligence Tests" on one hundred and three freshmen at the University of Texas, found these correlations with grades:—

| | |
|---|---|
| Card sorting— | .32 |
| Card dealing— | .25 |
| Alphabet dealing— | .17 |
| Mirror test— | 16 |

The average here is seen to be approximately .23.

Rowland and Lowden (4) in their attempt to determine the relative value of different groupings of tests given to students of Reed College, found that the highest correlation between any group of tests and college grades was .37, +.06 (Yule's formula). The tests selected, after discarding those which individually showed low correlations, were opposites, logical memory, rote memory, judgment and attention.

Waugh (5) gave seven tests to students entering Beloit College and correlated their performances with class standing. Correlations for the calcellation of A's, designed to measure concentration of attention, and for the puzzle box, which measured ingenuity, are not given since they were below .2. Correlations of the remaining tests with class standing appear below. Those relating to motor control are purposely omitted.

| | |
|---|---|
| Association (opposites) | .54 |
| Speed of learning (substitution) | .24 |
| Range of information | .47 |
| Memory (connected passage) | .40 |

The average is seen to be .41. Waugh's correlations for association and memory are much higher than Wissler's; his results from the attention test were evidently below .2 whereas it is one of the tests chosen by Rowland and Lowden for its high correlation. It would be difficult to determine whether such variations are due to inherent differences in the tests, or to differences in the methods of applying them, since neither tests or methods conform to any general standard.

Bell (6) used nine tests on 750 freshmen. His method differed from those preceding in that he adapted the tests for use with *groups*, the average time required to take all nine tests being forty-five minutes. The tests given were standard and well known.

Cancellation of triangles (after Simpson)
Addition (Simpson)
Association (adaption of Learning Pairs of Simpson and Thorndike)
Recognition
Selective judgment (Bonser)
Directions No. 1 (Woodworth and Wells)
Directions No. 2 (Woodworth and Wells)
Alternatives (Squire)
Completion (Terman and Childs)

The highest correlation obtained between class marks and any test score was .31 for the marks in English and the Completion test.

Kitson, (7), working with forty students in the College of Commerce and Administration of Chicago University, used many more tests than previous experimenters, sixteen in all, and found the correlation between standings in University grades for the year and standings in the tests to be .44. His tests were:—

1. Number checking (Woodworth and Wells)
2. Numbers heard (Whipple)
3. Objects seen
4. Logically related material, Heard
6. Logically related material, Seen

5, 7, 8, 9. Logically related material Heard and Seen, deferred reproduction.

10. Opposites (Woodworth and Wells)
11. Constant Increment (Woodworth and Wells)
12. Hard Directions (Woodworth and Wells)
13. Directions—Oral
14. Word-building (Whipple)
15. Sentence-building (Whipple)
16. Business Ingenuity.

These same tests used a year later with Freshmen gave a correlation with grades of only .20, which leads Kitson to conclude that "these results give point to the remark that the correlation between intelligence as measured by tests, and academic standing is not so high as is popularly supposed." A correlation of the test results with estimated intelligence, intelligence being defined as *ability to adapt one's self to new situations*, and estimated by the dean on the basis of the grades, but with liberty to change the ranking as he thought best, gave a result of .57 (P. E. .05). Kitson seemed not at all surprised at either correlation, since "an analysis of the conditions of University life shows that many other factors besides intelligence enter in to determine class-room standing."

King (8) gave the Completion, Hard Opposites, Logical Memory and Lanes Tests to students at the University of Iowa, obtaining a correlation of .41 between the results of the tests and class standing as estimated by certain instructors. He concludes that "in these tests we have measures of ability which should be of considerable value to advisory officers in a University."

King and M'Crory (9) used the following tests on about five hundred Freshmen at the University of Iowa:—

1. Courtis Standard Arithmetic Test-Series B
2. Mixed Relations (Whipple set)
3. Opposites (Simpson, rearranged by Gold and King)
4. Completion Test (Simpson)
5. Visualization (three inch cube test with each of the nine questions weighted and assigned a percentage value).
6. Range of Information (Whipple)
7. Logical Memory

Correlations are reported separately for boys and girls, and intercorrelations of tests are given as well as the correlation of each test with college grades. Combining the records of boys and girls, the average correlation of grades with the tests used seems to be .39. Of course this is only approximate, since to get an accurate coefficient, the boys and girls would have to be re-ranked together.

Dr. Starch told the writer that in correlating the results of the Stanford Adult tests with University standing (University of Wisconsin), and with estimated intelligence, the following coefficients of correlation were obtained:—

| | |
|---|---|
| Test results with grades | .30 |
| Test results with estimated intelligence | .75 |

Report of this investigation has not yet been published.

Miss Downey's work (10) deals with the Adult Intelligence Tests standardized by Terman, which were the ones used by the writer, and is therefore of more specific interest in this connection. The XVI and XVIII year old tests were given to thirty faculty members, thirty-two upper classmen and thirty-two freshmen, with these results; only one member of the faculty fell below the superior adult level as measured by the intelligence quotient, fifty percent fell within the very limited range of 110.4 to 113; two thirds of the upper classmen were in the superior adult group, one third in the average adult group, and fifty percent had I Q's between 104.1 and 113; of the freshmen, one third (approximately) were of superior, one half of average and one fifth of inferior intelligence. It is significant that all but one of the inferior group dropped out of college after the first year. Fifty percent of the freshmen ranged from 101.5 to 107 in I Q's.

The most surprising thing about Miss Downey's results is the massing of intelligence quotients in so limited a range for each group tested. Such a massing suggests the conclusion that the groups chosen for the tests were unusually homogenous, and seriously invalidates any conclusions from correlations, since it would be

impossible to eliminate the chance element in ranking say 15 persons between 110.4 and 113. Miss Downey herself partially recognizes this fact. "In conclusion, I would emphasize the value of the Stanford Adult Tests as a direct aid in analysis of an individual's make-up. Within a closely selected group, this value would outweigh that of expression of the results in terms of an Intelligence Quotient."

No attempt was made to correlate the test results with University grades, but a correlation of Miss Downey's ranking of her psychology class with the results of the tests gave .527 (P. E. .07). She believes that the agreement would have been closer but for error in her ranking due to an over-emphasis of the *verbal* factor, and goes on to say, "undoubtedly the most important source of error in judging intelligence is the undue emphasis laid upon verbal fluency as a social measure of general intelligence." We are at once reminded of Goddard's (11) warning that the higher grades of mental deficiency often pass for normality because of the verbal fluency of the persons affected, and it seems likely that the same error may be made in judging normal persons as of average, superior or very superior intelligence. Indeed we are left no room for doubt when we are told that faculty rankings (estimated intelligence) which failed to show any correlation with test results, gave a coefficient of correlation of .55 (P. E. .10) when compared with the results of the vocabulary test alone.

Finally, the tests were divided into three groups, *verbal, digit-span and constructive.* Those reagents of a literary turn of mind excelled in the verbal tests, those scientifically inclined scored higher on the constructive group, while results of the digit-span series showed no difference between groups. If further investigation with larger groups confirms these results we have some basis upon which advisory officers may build in helping the student select his courses.

*TABLE I a

Correlation of Results of Tests with College Grades

| | |
|---|---|
| Wissler— | .09 |
| Calfee— | .23 |
| Rowland & Lowden— | .37 |
| Waugh— | .41 |
| Bell— | .31 |
| Kitson— | .44 |
| King & M'Crory— | .39 |
| Caldwell— | .44 |

TABLE I b

Correlation of test results with estimated intelligence

| | |
|---|---|
| Kitson— | .57 |
| King— | .41 |
| Downey— | .527 |
| Caldwell | .47 |

The present investigation was made in 1916-17 while the writer was a teacher of psychology at Randolph-Macon Woman's College. Six members of the class on Mental Tests, all seniors, were trained in the technique of the Stanford Revision. Each girl tested a number of subjects under the direct supervision of the author, and had careful instructions in scoring. Not until all were thoroughly familiar with the use of the tests was the work here reported begun. Forty-eight students, twenty-four Sophomores and twenty-four Juniors were used as subjects. The XVI and XVIII year old Terman Tests were used, and all alternates were given, regardless of the performance in the original tests.

For convenience, the Average Adult Tests (XVI years) will be referred to as I-1, I-2, I-3, I-4, I-5, I-6, Al 1 and Al 2, and the Superior Adult Tests (XVIII years), as II-1, II-2, II-3, II-4, II-5, II-6. Careful record was kept of the nature of each wrong response given by each subject. So far as was possible, a verbatim record of the answers was taken. This made it possible to rank, with a fair degree of accuracy, students whose intelligence quotients were the same. I. Q's were computed after Terman (12) by dividing the age, as determined by the tests, by 16, which is taken as the adult age. Each score sheet was inspected by the writer immediately after the completion of the test so that any obscure points might be cleared up while the matter was fresh in the mind of the examiner who had acted as experimenter. It may be added that no experimenter was given a subject with whom she was on familiar terms, lest such familiarity invalidate the results.

Next, four members of the faculty and two students ranked the subjects tested as to intelligence, the latter being defined by general consent as, *general ability to adapt oneself to practical situations.* The average rating for each girl was taken as the basis for compu-

*It may be of interest to know that use of the Yerkes-Bridges Point Scale by Garrison, at the Peabody College for Teachers yielded a correlation of test results with grades of only .21. There is no statement that the Yerkes-Rossy scale for adults was the one used. Yerkes and Burt report relations between results of tests by the Yerkes-Rossy scale and a set of psychology grades, using the method of tertiles, claiming a positive correlation, but giving no coefficient.

tation. Lastly, the average grade of each girl since entering college was calculated from the registrar's record books, grades in all courses for each year being made the basis of calculation. Correlations were then obtained by the Pearson Rank Method, for the two groups (Juniors and Sophomores) separately, and for all subjects ranked together. These correlations are given in the form of a table below:—

TABLE II

Correlations of Results of Stanford Adult Tests with College Grades.

| | |
|---|---|
| **Juniors** | |
| Intelligence quotient and grades— | .69 |
| Intelligence quotient and estimated intelligence— | .46 |
| Estimated intelligence and grades— | .52 |
| **Sophomores** | |
| *Intelligence quotient and grades— | .17 |
| Intelligence quotient and estimated intelligence— | .50 |
| Estimated intelligence and grades— | .38 |
| **Juniors and Sophomores—Re-ranked in One Group** | |
| Intelligence quotient and grades— | .44 |
| Intelligence quotient and estimated intelligence— | .47 |
| Estimated intelligence and grades— | .37 |
| *Omission of three widely varying records here gives | .48 |

It is a recognized fact that no intelligence tests are complete without some knowledge of the character and environment of the subjects tested. Such knowledge often gives the key to discrepencies which appear when the data are handled mathematically. There is grave danger that in the attempt to standardize tests and evaluate results the more subtle factors entering into success or failure in performance will be overlooked.

In the Sophomore Group, the low correlation of Intelligence Quotient with Grades is directly traceable to the records of three students. Number one was ranked one and a half in the tests and fifteenth in grades. She was a girl whom everybody liked, and was naturally bright, but her popularity together with a natural disinclination toward exertion caused her to do little studying. But for her native ability she could not have maintained herself in college. Number two, also bright and peculiar, was engaged in

*The author is not prepared to enter into a discussion regarding the relative merits of the Stanford Revision and the Point-Scale, but either of these is preferable to a set which is *as a whole* unstandardized, even though norms for the separate tests have been carefully worked out and standardized.

almost every outside activity which the college afforded, greatly to the detriment of her class standing. She was allowed to return for her Junior year on probation because of her popularity and promise. Number three was an excellent talker, and never failed to recite whether she knew much about the subject or not. This is perhaps the best example in these results of over-rating due to verbal fluency mentioned by Miss Downey. The girl ranked fourth in grades, given largely because of her readiness to recite and her general "well-meaningness" as one student described it, but was twenty-fourth in the tests. When these three records are omitted, the correlation between intelligence quotient and grades for the Sophomores is .48.

This correlation while somewhat closer than any reported above, still lacks much of being as marked as that of the Juniors. There may be several reasons for this difference. The Juniors are, as a rule, steadier, less erratic, less given to outside distractions than the Sophomores, and put forth more uniform effort in daily work. Hence their grades more exactly represent their ability, and correlate more closely with the net results. Again, the grades from which the Sophomore rankings are obtained are almost entirely those of required subjects, while in the Junior rankings are included a full year of electives. As a rule, students are more interested and hence do better work in subjects which they elect than in subjects which are required, and here again the Junior grades would be a more accurate index of ability than the Sophomore grades. It is also quite probable that the somewhat greater maturity of the Juniors plays its part, the age range here being eighteen to twenty-three, while in the Sophomore group it is seventeen to twenty.

In the re-ranking of the two groups as one, even though the three records discussed above are included, the coefficient of correlation between the grades and intelligence quotient is higher than any yet obtained except that of Kitson. When the complexities of the grading system in the average college are considered a closer correlation is scarcely to be expected.

The same sources of error apply in estimating intelligence as in giving grades, and in every case where there is wide variation in rank between estimated intelligence and test results, the reason is to be found in a close study of the character of the subject, as, for example, in the case of the student who was commonly very quiet, and gave the impression of being quite ordinary because "she

never had anything to say for herself," but who had the gift of rising to emergencies such as written tests and examinations, and who ranked second in grades, sixth in the tests, but twentieth in estimated intelligence.

Comparing the coefficient of correlation between the test ratings and estimated intelligence with those obtained by previous experimenters shows it to be higher than King's, but lower than Kitson's or Miss Downey's. The two last, however, reported estimated intelligence on the basis of one person's judgment only, while the ranking in King's report was done by two or three instructors and in the present research by six persons.

It was at first a matter of some surprise to the author that there was no evidence of closer correlation between estimated intelligence and grades, since grades must certainly be taken largely as a basis of estimate, certainly on the part of an instructor. But when the definition of "intelligence" used in making the ranking is considered, one sees that there may be many things besides classroom work which strongly influence the estimation of intelligence, and there may have been also a conscious effort on the part of the faculty members not to allow the high or low standing of the students in their particular classes to exert too strong an influence on the ranking—an effort which may easily have resulted in too low or too high a ranking, as the case might be. Unfortunately there are no reported correlations with which this coefficient may be compared.

Turning next to the results of the separate tests, we find in Table III the percentage of failures on each test for each class.

TABLE III

| Sophomores | | Juniors | |
|---|---|---|---|
| Test | % failures | Test | % failures |
| I–1 | 33⅓ | I–1 | 12½ |
| I–2 | 12½ | I–2 | 12½ |
| I–3 | 25 | I–3 | 12½ |
| I–4 | 37½ | I–4 | 37½ |
| I–5 | 33⅓ | I–5 | 29 1-6 |
| I–6 | 29 1-6 | I–6 | 29 1-6 |
| A1 1 | 58½ | A1 1 | 62½ |
| A12 | 83⅓ | A12 | 62½ |
| | | | |
| II–1 | 70 | II–1 | 50 |
| II–2 | 25 | II–2 | 42 |
| II–3 | 42 | II–3 | 12½ |
| II–4 | 46 | II–4 | 33⅓ |
| II–5 | 54 | II–5 | 70 |
| II–6 | 50 | II–6 | 62 |

The fact that in both the sophomore and junior years the alternate tests for the Average Adult Group show a much higher percentage of failures than the regular tests, would seem to throw some doubt upon either their value or their proper placing, and to suggest that if used at all, they perhaps belong in the Superior Adult Group.

Terman himself criticises these tests, Alternate *one* as "too mechanical to tax very heavily the higher thought processes," while of Alternate two he says, "These problems – – – yield interesting results when properly given, but are not without their faults. Sometimes a V S (very superior) subject fails, while occasionally an I (inferior) subject unexpectedly succeeds."

This was exactly the experience of the writer with these tests, but she did not find 60 to 75 percent of average adults passing, and few if any superior adults failing, as did Terman, for 50% of the failures on AI 1 and 46% of those on AI 2 were by students whose I Q was above 110.

The results of this study raise one more question. It is as to the value of the tests classed by Miss Downey as *digit-span tests*, which we shall designate *pure auditory memory tests*. A number of students who ranked high in both estimated intelligence and grades, missed only those questions in the tests involving auditory memory, i, e, I-5, AI 1, II-3 and II-5, thus falling far below in their test rankings. Whatever may be the value of the test for immediate memory, is it not overdoing it somewhat to have three such tests in the determination of adult intelligence, and two of them in one group of six tests, thus constituting 1-3 of the score for that group? Granting that the process of giving the digits in reverse order may possibly involve more than mere immediate memory, that must still be involved, and it seems to the writer that it would be better to replace at least one of these tests with a requirement involving some other ability.

Attention is also called to the fact that the highest I Q possible of attainment by an adult is 121.8. This is near the lower limit of Very Superior Intelligence as designated by Terman, and makes the determination of an adult genius or near-genius impossible. Something should be done to make the scale flexible enough and extensive enough to apply to upper as well as lower limits of intelligence. This is a fault, if fault it be, common to all intelligence tests, that they select inferior individuals much more readily than they do superior ones. From a vocational standpoint this is a less

costly fault than the reverse would be, but it is highly desirable from both the educational and the vocational point of view that there be some better way of selecting those persons who will prove most worthy of intensive and specialized training.

## Conclusions

1. The correlation of the test results with scholastic standing is such that the Adult Tests may be useful to advisory officers in diagnosing cases of unsatisfactory scholarship, whether among Freshmen or Upper-classmen. Indeed the value of the tests in this particular would probably increase with advance in standing. A further use of the tests might be made in colleges where a long waiting list is the rule, in order to weed out undesirable candidates for admission.

2. Since the correlation of these test results with grades is as high as that found with any other set of tests, (see table Ia), it is to be recommended that the *Stanford Adult Tests, which have the advantage of being standardized, be used in investigations regarding adult intelligence in order that there may be a common basis for the comparison of results.

3. The tests need revision in a few particulars. The alternate tests for the Average Adult are either wrongly placed or should be changed, and there seem to be relatively too many pure auditory memory tests in the Superior Adult Group.

4. The Intelligence Quotients for adults have less meaning than those for children, and there should be some means for denoting higher adult I Q'S.

5. I Q's must always be interpreted in the light of character study, and standardized character tests in addition to these adult tests are highly desirable.

6. A productive field for further work along this line would lie in the application of the Stanford Adult Tests to persons selected for their brilliancy, in order to determine—

   a. the possible limits of performance
   b. the percentage of failures in each part of the test
   c. The extent to which Miss Downey's division into Literary and Scientific groups on the basis of performance may be expected to hold.

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# A TEST IN LATIN[1]

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*Preparation of the test.* There are at least four desirable conditions which an educational test or scale ought to satisfy as nearly as possible. (1) The test or scale for a given subject should measure the knowledge or skill acquired wherever proper instruction or training in that field is provided. The material of the test should be based upon the material that has actually been covered or should be covered in the subject. (2) The test ought to permit of accurate, impersonal evaluation. (3) It ought to permit of duplication or repeated application almost indefinitely. (4) It ought to measure adequately the knowledge, skill or ability for which it is designed. The present Latin test has been prepared with reference to these four criteria.

The first criterion may be satisfied rather easily in preparing a Latin test since the content of Latin in the high school is more nearly standard or uniform than it is in most other subjects. Excepting certain variations in the first year of Latin, the classical texts studied are the same wherever Latin is taught, namely, Caesar, Cicero, and Virgil.

The test as finally constructed is composed of two parts, a vocabulary test and a translation test. The vocabulary test is composed of 100 words selected from Lodge's "The Vocabulary of High School Latin" by choosing every 20th word. Lodge's Vocabulary list contains the 2000 words occurring in Caesar, Cicero, and Virgil.

The translation test is composed of four parts, one for each of the four years of high school Latin. The first year test is composed of twenty sentences selected from five widely used first year tests. Four sentences were chosen at uniform intervals from each of the five texts.[1] For example, Pearson's Essentials of Latin contains 857 sentences. If the 98th sentence was the first one chosen, the other three would be the 312th, the 526th and the 740th. That is,

[1] The preparation of the test itself and the compilation of the results were carried out by Mr. J. M. Watters under the direction of the writer.

[2] Pearson's Essentials of Latin; Smith and Lange's First Latin Lessons; Collra and Daniel's First Year Latin; Bennett's First Year Latin; and D'Ooge's Latin for Beginners.

they were chosen at intervals of 214 sentences. The only restrictions observed were that the sentences must contain no less than three words at least two of which must be of different parts of speech. In like manner four sentences were chosen from each of the other four texts. The only difference was that in the texts containing varying numbers of sentences, the interval varied accordingly. For example, D'Ooge's Latin for Beginners contains 490 sentences. The four sentences were selected at intervals of 122 sentences. The sentences from the different texts were then arranged alternately.

The seven sentences for the second year test were selected from Caesar at intervals of twenty-two chapters with the exception that Chapters I and XIV of Book I and Chapter XVII of Book IV were omitted because the first one is frequently memorized and the others present unusual difficulties of translation. The only further restrictions observed in the selection of the sentences were that they must contain no less than six words nor more than thirty-five. In case a sentence failed to meet these restrictions the sentence preceding or following was chosen. For the particular test here used the second sentence of Chapter IV of Book I was the first one selected. The other six sentences were obtained by selecting the second sentence of every 22nd chapter thereafter as just mentioned.

The seven sentences for the third year test were chosen at regular intervals from the four orations against Cataline, the oration for the Manilian Law and the oration in behalf of Archias. The four orations against Cataline and the one in behalf of Archais are approximately equal in length while the one for the Manilian Law is about twice as long as any of the others. This oration was divided into two parts of twelve chapters each. Subject to the same reservations followed in connection with the Caesar test, the seven sentences were chosen by taking the fourth sentence of the third chapter of each of the four orations against Cataline, the oration for the Manilian Law, and each of the two parts of the oration in behalf of Archias.

The ten sentences for the fourth year test were chosen from Virgil at intervals of 500 lines beginning with the 88th line. The first sentence could not be selected from among the first fifty lines since these are frequently memorized.

The idea governing the selection of this particular amount of material for each of the four translation tests was to limit it so

that it could be done as a test within a class period. The aim was to limit the amount for each year test to approximately 125 to 150 words.

Comparison of Test No. I and Test No. II in First Year Latin Percentage Scores

| | No. of Words | First 100 Sentences |
|---|---|---|
| Test I | 122 | 84.3 |
| Test II | 139 | 83.0 |

Comparison of Tests No. I and No. II in Caesar

| | No. of Words | Percentage Scores |
|---|---|---|
| Test I | 154 | 72.9 |
| Test II | 142 | 76.2 |

The second desirable feature of an educational test is accuracy and objectivity in the evaluation of the result. The specifications for scoring the vocabulary test are as follows:

> Determine the number of words correct, count each word as either right or wrong. Any accepted meaning is considered correct. However, a meaning such as *four* for *quartus* is considered incorrect.

Two methods of scoring the vocabulary test were tried out and compared. One was the plan here adopted, namely, of having the pupils write the English meaning of the Latin word. The other was the matching plan which consisted of presenting the Latin words on one side of the page and the English equivalents numbered and arranged in alphabetical order on the other side. The task of the pupil was to write the number of the English equivalent after each Latin word. The two methods were employed with a class of fifteen students with the outcome that the former plan was adopted. The two methods produced substantially the same scores. The average score by the defining method was 26.4 and by the matching method 23.7. The second or matching plan has the advantage of being entirely impersonal and objective, but it has the disadvantage of requiring too long a time on the part of the pupil to do the test and also of using meanings which for particular Latin words may be unfamiliar to the pupil. The defining method involves to some extent the element of judgment as to whether the meaning given by the pupil is satisfactory. However, this element is slight from the practical viewpoint. The defining method is on the whole the more desirable one.

The translation test is scored as follows:

> Consider the translation correct if the thought is rendered correctly. A word may be rendered incorrectly in two ways, either in meaning or in its relation to other words, each counting as a half point. For example: "His

rebus cognitis" may be six half points, three in meaning and three in grammar. "These things having been learned," or "After he had learned these things" would be correct translations and would receive the full credit of three points or words. But in the translation, "You learned the things from these" each word is grammatically wrong even though the meanings of the words individually are correct. Hence, it will receive three half points or one and one-half points. After determining the total number of points made in the test for a given year, compute the percentage of these points on the total number of the words in the test. For example, a pupil who made 83 points on the first test out of a total of 122 possible points or words would receive a score of 68 per cent.

This method of scoring seemed the most adequate in that it takes account of the meanings of words as well as of their grammatical relations and as such has not only the advantage of accurately evaluating the work of the pupil but also of locating precisely the weakness of the pupil, that is, whether the pupil is deficient in the knowledge of words or in the knowledge of grammar.

The method of scoring adopted both for the vocabulary and for the translation parts of the test are convenient, relatively simple, and involve a minimum of judgment on the part of the examiner.

The third desirable feature of a test is the possibility of sufficient duplication so that if pupils coach up on the test other tests of presumably corresponding value and difficulty may be substituted. This is a highly desirable feature of any educational test. When a test is being used extensively it becomes familiar to both teachers and pupils and tends thereby to lose its measuring value. This condition will have to be met by all tests that are to be used continuously and frequently and one of the important values of tests will be their continued use at frequent intervals.

The underlying motive in the preparation of the present test has been to meet this fundamental condition. The test has consequently been so constructed that it can be duplicated indefinitely with very little expenditure of time or effort. For example the vocabulary test may be duplicated to the extent of twenty sets of 100 words each which would consume the 2000 words of Lodge's list. If pupils should coach up on a given list, any other may be easily substituted and if they should coach up on the entire 2000 words so much the better. They would then have substantially the entire vocabulary of high school Latin.

The translation test can likewise be duplicated to the extent of consuming the entire text material used in the four years of high

school Latin by following the simple instructions used in the preparation of the test here presented. Later in this paper data will be presented to show the extent to which various tests made up in this manner are comparable or of similar difficulty. It will be found that they agree quite closely.

*Adequacy of the test.* Two questions regarding the adequacy or reliability of this test arise. First, How adequately does the present test measure the attainment in Latin? Second, How closely do the measures obtained for one test, made up in the manner here proposed, compare with any other test made up in a like manner?

Probably very little doubt concerning the general fairness and adequacy of the test will arise in the mind of anyone who makes a critical study of it for the reason that the method of the test is essentially similar to that ordinarily employed by teachers.

The second question regarding the adequacy of the method is fundamental to the viewpoint here adopted. How do various tests prepared according to the specifications previously stated compare with one another in difficulty and reliability? To answer this question definitely by means of experimental data, two sets of vocabulary and two sets of translation tests for the first year and two sets for the second year were prepared and given to the same pupils. The following table gives the scores made in the two first-year tests by a class of nine pupils in first year Latin and the scores made in the two Caesar tests by a class of twelve pupils in the second-year Latin.

Comparison of Test No. I and Test No. II in First Year Latin.
Percentage Scores.

| | No. of Words. | First 10 Sentences. |
|---|---|---|
| Test I | 122 | 84.3 |
| Test II | 139 | 83.0 |

Comparison of Tests No. I and No. II in Caesar.

| | No. of Words. | Percentage Scores. |
|---|---|---|
| Test I | 154 | 72.9 |
| Test II | 142 | 76.2 |

The scores for the two first year tests are based on the first ten sentences of the test since the pupils were not allowed sufficient time to complete all of the second test. These results show a remarkably close agreement in the measurement of the same pupils

by two different tests prepared in the same manner. There is a difference of only 1.3 points between the two first year tests and of 3.3 points between the second year tests. These differences are negligible as compared with the gross scores. It is evidently possible to prepare tests according to the principle here proposed, to use them interchangeably and to measure pupils with considerable accuracy.

A further study of the same point was made by comparing the scores made by the same pupils on the odd numbered sentences with those made on the even numbered sentences of the same test. This was done for the first year and the second year tests as shown in the following table:

Comparisons of Two Divisions of First Year Test No. I

| | No. Wds. in Test | No. Pupils | Percent Correct |
|---|---|---|---|
| All of Test | 122 | 122 | 68.4 |
| Odd Sentences | 57 | 122 | 69.5 |
| Even Sentences | 65 | 122 | 67.4 |

Comparison of Two Divisions of Caesar Test No. I

| | No. Wds. in Test | No. Pupils | Percent Correct |
|---|---|---|---|
| All of Test | 154 | 96 | 62.4 |
| Odd Sentences | 95 | 96 | 61.6 |
| Even Sentences | 59 | 96 | 63.5 |

The scores on the two halves of each test agree very closely. The difference between the two halves of the first year test was 2.1 points and between the two halves of the second year test, only 1.9 points. These comparisons corroborate the fact that measurements obtained from any one test will be very closely comparable with those obtained from any other test prepared in the same manner.

*Results.* The test was given in the spring of 1918 to nearly 1000 pupils in thirteen high schools in five states, namely, Illinois, Michigan, Ohio, Tennessee, and Wisconsin. The schools varied in the number of Latin pupils from twenty to 300. The scores for the different schools and the number of pupils in each school are given in the following table:

VOCABULARY TEST

Averages by Schools

| School | Averages | | | | No. of Pupils | | | |
|---|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | I. | II. | III. | IV. |
| A | 45.1 | | | | 16 | | | |
| B | 21.8 | 38.5 | | 50.1 | 67 | 48 | | 12 |
| C | 25.3 | 34.2 | | 72.8 | 19 | 11 | | 4 |
| D | 64.7 | | 66.4 | 81.0 | 15 | | 15 | 18 |
| E | 30.0 | 42.9 | | 73.5 | 4 | 7 | | 4 |
| F | 37.5 | 49.2 | 62.3 | | 11 | 12 | 11 | |
| G | 33.7 | 56.8 | 63.3 | | 9 | 13 | 4 | |
| H | 32.0 | 51.0 | | | 6 | 6 | | |
| I | 44.4 | 59.5 | 74.0 | 83.3 | 13 | 28 | 2 | 3 |
| K, L, M | 29.7 | 39.0 | | 64.0 | (About 300) | | | |
| Ave. | 30.1 | 45.9 | 67.2 | 69.9 | 160 | 125 | 32 | 41 |

TRANSLATION TEST

Percentage Scores

| School | Per cent Correct | | | | Number of Pupils | | | |
|---|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | I. | II. | III. | IV. |
| A | 57.7 | | | 54.5 | 25 | | | 8 |
| B | 43.9 | 56.4 | | 44.3 | 67 | 48 | | 12 |
| C | 60.1 | 62.6 | | 60.7 | 19 | 9 | | 4 |
| E | 82.9 | 64.9 | | 90.8 | 3 | 9 | | 4 |
| F | 84.7 | 76.1 | 59.5 | | 11 | 12 | 12 | |
| G | 71.6 | 72.9 | | 59.9 | 9 | 12 | | 5 |
| H | 72.3 | 73.4 | | 88.6 | 6 | 6 | | 1 |
| J | 87.3 | | | | | | | |
| K, L, M | 69.4 | | | | (About 300) | | | |
| Ave. | 63.1 | 62.4 | 59.5 | 57.7 | 184 | 96 | 12 | 34 |

On the basis of these results the following scores may be proposed as tentative June standards (Medians):

| Years of Latin | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Vocabulary—No. of words | 35 | 50 | 65 | 80 |
| Translation—Percentage scores | 70 | 72 | 62 | 62 |

The averages given for the different years are not averages of the schools but are averages of the total number of pupils who did the test.

The proposed standard scores are medians and are somewhat higher than the averages for the corresponding years owing to the fact that the averages were brought down by a small number of rather defective pupils particularly in the upper years. The differ-

ences among the scores for the different schools are exceedingly large. For example, in the vocabulary test the first year classes, ranged from 21.8 in one school to 64.7 in another school. In the translation test the first year classes ranged from a score of 43.9 to 87.3. It will be noted that school B which stood low in the vocabulary test also stood low in the translation test. Similar comparisons for the different years show similar differences. School B, one of the largest high schools in the list, is consistently low in all the years of the high school.

The next table shows the attainment at half year periods for 56 first year pupils and 184 second year pupils. The figures show the gain made in each half year.

| Year I | First Sem. | Second Sem. | Difference | Percent Gain |
|---|---|---|---|---|
| Vocab. | 14.3 | 30.1 | 15.8 | 110.5 |
| Trans. | 36.9 | 63.1 | 26.2 | 71.6 |
| Year II | First Sem. | Second Sem. | Difference | Percent Gain |
| Vocab. | 25.0 | 45.9 | 20.9 | 83.6 |
| Trans. | 40.4 | 63.7 | 23.3 | 57.6 |

The next point of interest is the distribution of the individual scores and the overlapping of the pupils in the different years of Latin.

Distribution and overlapping of pupils in the various years. The table reads thus: Thirty pupils with 1 year of Latin had a vocabulary score between 11 and 20, 49 a score between 21 and 30, etc.

VOCABULARY TEST

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4th year | 1 | 1 | 3 | 1 | 1 | 6 | 15 | 10 | 3 |
| 3rd year | | | | 3 | 14 | 11 | 5 | 1 | |
| 2nd year | 6 | 18 | 29 | 25 | 26 | 17 | 2 | 2 | |
| 1st year | 30 | 49 | 38 | 12 | 14 | 2 | | | |
| Scores (Words) | 11–20 | 21–30 | 31–40 | 41–50 | 51–60 | 61–70 | 71–80 | 81–90 | 91–100 |

TRANSLATION TEST

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4th year., 2nd Sem. | | 3 | 4 | 5 | 7 | 6 | 5 | 3 | 1 |
| 3rd yr., 2nd sem. | | | | 4 | 5 | 3 | | | 4 |
| 2nd sem. | | 6 | 5 | 7 | 17 | 21 | 22 | 12 | 4 |
| 2nd yr., 1st sem. | 5 | 2 | 6 | 3 | 4 | 1 | 2 | | |
| 2nd sem. | 5 | 6 | 22 | 24 | 28 | 18 | 29 | 27 | 25 |
| 1st yr., 1st sem. | 4 | 16 | 16 | 9 | 7 | 3 | 1 | | |
| Percent Scores | 11–20 | 21–30 | 31–40 | 41–50 | 51–60 | 61–70 | 71–80 | 81–90 | 91–100 |

These results are typical of what has been found in practically every school subject in which comparative tests have been applied. Thus according to the vocabulary test there are some pupils in the fourth year of Latin who know no more words than the poorest pupils in the first year; and the best pupils in the first year know as many words as the average pupil in the fourth year. A similar comparison may be made on the basis of the translation test. However, in the above table the comparison can be made only for the two semesters of a given year since a different test is used each year. A comparison of any year may be made with any other year by giving the same translation test to both classes.

The next question is the relation between the knowledge of vocabulary and the ability to translate. The following table gives the coefficients of correlation between the vocabulary and the translation test for the pupils in four classes.

| School | Year | No. of Pupils | Coefficient of Correlation |
|---|---|---|---|
| B | I | 18 | .67 |
| B | II | 21 | .82 |
| B | IV | 12 | .52 |
| C | I | 19 | .52 |

These correlations are fairly high and indicate that knowledge of vocabulary and ability to translate tend to go together rather closely.

The length of the sentence is usually considered important in translation. Longer sentences are considered much harder. The test contains sentences of varying length. The percentage of accuracy of translation for different sentences is given in the following table:

FIRST YEAR TEST

| Sen. No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Wds. in Sen. | 6 | 6 | 4 | 5 | 5 | 8 | 5 | 4 | 6 | 12 |
| Percent Correct | 81.7 | 79.7 | 63.3 | 83.1 | 85.7 | 81.3 | 84.8 | 66.4 | 82.7 | 64.4 |
| Sen. No. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Wds. In sen. | 6 | 10 | 9 | 3 | 6 | 4 | 7 | 4 | 3 | 9 |
| Percent Correct | 71.8 | 61.7 | 58.8 | 57.5 | 73.2 | 65.3 | 44.9 | 58.8 | 50.2 | 57.1 |

This table indicates that length of sentence does not materially affect the accuracy of translation. The correlation between length of sentence and percentage of accuracy is only .02 for the first year test and .31 for the second year sentences.

Another point of interest is the comparison of the sexes. The following table gives the scores for both the vocabulary and the translation test of pupils who had studied Latin for half a year, one year, and two years. The results show no consistent difference and the probability is that boys and girls are substantially equal in their capacity to study Latin.

COMPARISON OF BOYS AND GIRLS

| Years of Latin | Half Year | | 1 Year | | 2 Years | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| No. Pupils | 24 | 32 | 69 | 86 | 25 | 57 |
| Vocabulary | 13. | 14.5 | 25. | 28. | 40. | 38. |
| Translation | 29.5 | 35.2 | 59. | 55 | 61.7 | 65. |

LATIN TEST—SERIES A

VOCABULARY TEST

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | a, ab, abs | 26. | latus | 51. | valles | 76. | aer |
| 2. | aditus | 27. | maneo | 52. | video | 77. | apto |
| 3. | affero | 28. | moror | 53. | auspicium | 78. | arvum |
| 4. | alius | 29. | nemo | 54. | claudo | 79. | caeli-cola |
| 5. | ante | 30. | ob | 55. | conscientia | 80. | compono |
| 6. | avis | 31. | opera | 56. | curia | 81. | corripio |
| 7. | captivus | 32. | orior | 57. | dignitas | 82. | donum |
| 8. | cibus | 33. | passus | 58. | erumpo | 83. | equidem |
| 9. | cohors | 34. | permitto | 59. | excito | 84. | famulus |
| 10. | concilium | 35. | plerusque | 60. | exsul | 85. | frigidus |
| 11. | congredior | 36. | postea | 61. | flos | 86. | gemitus |
| 12. | contra | 37. | praefero | 62. | indicium | 87. | implico |
| 13. | de | 38. | pridie | 63. | inquam | 88. | laevus |
| 14. | defigo | 39. | proficiscor | 64. | meus | 89. | liquidus |
| 15. | detrimentum | 40. | puer | 65. | municipium | 90. | magister |
| 16. | distribuo | 41. | quartus | 66. | otium | 91. | memoro |
| 17. | duplex | 42. | quod | 67. | prospicio | 92. | nodus |
| 18. | ferus | 43. | remitto | 68. | regius | 93. | obsto |
| 19. | fossa | 44. | sexaginta | 69. | sanguis | 94. | pelagus |
| 20. | gladius | 45. | sinister | 70. | securis | 95. | rapio |
| 21. | hospitium | 46. | studium | 71. | sollicito | 96. | reviso |
| 22. | ignosco | 47. | supero | 72. | tego | 97. | sacro |
| 23. | incido | 48. | tam | 73. | utinam | 98. | sterno |
| 24. | ipse | 49. | tollo | 74. | veneror | 99. | turba |
| 25. | iustitia | 50. | triumpho | 75. | vito | 100. | uro |

FIRST YEAR LATIN

1. Cur in pulchram insulam frumentum partamus?
2. Equus niger viri in silva est.
3. Agricola poetis insulam monstrat.

4. Multi milites castra Gallorum oppugnant.
5. Filia agricolae est grata dominae.
6. Caesar veteres milites amabat, quod bello fortes erant.
7. Galli et Germani dissimillimi erant.
8. Quae arma militimus fuerunt.
9. Magnum numerum equitum et peditum habebimus.
10. Ubi oppidum a perfido Sexto Occupatum est, oppidani miseri gladio interfecti sunt.
11. Legatus multo fortior est meo fratre.
12. Imperator legatum misit ut in citeriore Gallia novos milites conscriberet.
13. Ruri sunt viae pedibus multis angustiores quam in urbe.
14. In Galliam contendimus.
15. Aestate dies sunt longiores quam heime.
16. Cur hostes se receperunt?
17. Si telis uti potuissent, non victi essent.
18. Nolite consilia malorum audire.
19. Cum venies, cognosces.
20. Cum principes inter se obsides darent, Romani bellum paraverunt.

SECOND YEAR LATIN. Caesar.

1. Die constituta causae dictionis Orgetorix ad iudicium onmem suam familiam, ad hominum milia decem, undique coegit et omnes cliente obraetosques suos, quorum magnum numerum habebat, eodem conduxit; per eos ne causam diceret se eripuit.

2. Qui cum itinere convenissent seque ad pedes proiecissent suppliciterque locuti flentes pacem petissent; atque eos in eo loco quo tum essent suum adventum exspectare iussisset, paruerunt.

3. Primam et secundam aciem in armis esse, tertiam castra munire iussit.

4. His rebus cognnitis exploratores centurionesque praemittit qui locum castris idoneum deligant.

5. Brevi spatio interiecto, vix ut iis rebus quas constituissent conlocandis atque administrandis tempus daretur, hostes ex omnibus partibus signo dato decurrere, lapides gaesaque in vallum coicere.

6. Tum vero clamore ab ea parte audito nostri redintegratis viribus, quod plerumque in spe victoriae accidere consuevit, acrius impugnare coeperunt.

7. Neque enim temere praeter mercatores illo adit quisquam, neque his ipsis quicquam praeter oram maritiam atque eas regiones quae sunt contra Gallias notum est.

THIRD YEAR LATIN. Cicero.

1. Num me fefellit, Catilina non modo res tanta, tam atrox, tamque incredibilis, verum, id quod multo magis est admirandum, dies.

2. Video cui sit Apulia attributa, quis habeat Etruriam, quis agrum Picenum, quis Gallicum, quis sibi has urbanas insidias caedis atque incendiorum depoposcerit.

3. Etenim, Quirites, si ea quae erant ad me delata reperta non essent, tamen ego non arbitrabar in tantis rei publicaee periculis esse mihi nimiam diligential pertimescendam.

4. Sed ego institui referre ad vos, patres conscripti, tamquam integrum, et de factor quid iudicetis et de poena quid censeatis.

5. Verum tamen illis imperatoribus laus est tribuenda quod eregunt, venia danda quod reliquerunt, propterea quod ab eo bello Sullam in Italiam res publica, Murenam Sulla revocavit.

6. De quo homine vos, id quod maxime facit auctoritatem, tanta et tam praeclara iudicia fecistis?

7. Itaque hunc et Tarentini et Locrenses et Regini et Neapolitani civitateceterisque praemiis donuarunt, et omnes, qui aliquid de ingeniis poterant iudicare, cognitione atque hospitio dignum existimarunt.

FOURTH YEAR LATIN. Virgil.

1. Eripiunt subito nubes caelumque diemque
   Teucrorum ex oculis; ponto nox incubat atra.
2. Vix ea fatus erat, cum circumfusa repente
   scindit se nubes et in aethera purgat apertum
3. Iam Deiphobi dedit ampla ruinam
   Vulcano superante domus, iam proximus ardet
   Ucalegon, Sigea igni freta lata relucent.
4. Vix Prima inceperat aestas
   et pater Anchises dare Fatis vela iubebat.
   litora cum patriae lacrimans portusque relinquo
   et canoism ubi Troia fuit.
5. Sternimur optatae gremio telluris ad undam
   sortiti remos passimque in litore sicco
   corpora curamus; fessos sopor inrigat artus.
6. Ocius omnes imperio laeti parent et iussa facessunt.
7. Ille agmine longo
   tandem inter pateras et levia pocula serpens
   libavitque dapes rursusque innoxius imo
   successit tumulo et depasta altaria liquit.
8. Hic primum Fortuna fidem mutata novavit.
9. At pius Aeneas ingenti mole sepulcrum
   inponit suaque arma viro, remumque tubamque,
   monte sub aerio, qui nunc Misenus ab illo
   dicitur aeternumque tenet per saecula nomen.
10. Hinc metuunt cupiuntque, dolent gaudentque, neque auras
    dispiciunt clausae tenebris et carcere caeco. [1]

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(1) Copies of the tests may be obtained from the University Cooperative Co., Madison, Wisconsin.

# DETECTING THE FEEBLE-MINDED IN A CITY SCHOOL POPULATION

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THE examination work reported herein was undertaken for the Board of Education of Columbus, Ohio, by the Ohio Bureau of Juvenile Research. Every school in the city was visited in the years 1915-17 and all the feeble-minded children discovered were reported to the principals of the schools and to the superintendent. The results of some of the earliest work have unfortunately been mislaid and are not now available. Some of the schools had been canvassed by students of the department of psychology of the Ohio State University. The work of these students was not duplicated since the school authorities had been informed as to the defectives in these schools. The thirty-eight schools reported herein had an aggregate enrollment of 18,223 at the time of the examinations. This represents more than three-fourths of the school population of the City.

The method of procedure in a school was for the examiner to tell the principal the object of the visit and let the principal bring forth such children as she wished to have examined. As would be expected the personal attitude of principals was very different upon this matter. In some schools the examiner was left very much in doubt as to whether all the children who might be feeble-minded were brought forward, and in other cases the tendency was to use the occasion of the psychologist's visit for getting intelligence ratings upon as many of the children as possible. The number of children selected by principals for examination bears no constant relation to the number of feeble-minded discovered. In addition to this we must bear in mind the reference of Binet to the poor quality of judgment teachers have in respect to mental abilities of their pupils, and in fact to the bias which familiarity seems to work in the judgment of any one in respect to the intelligence assessment of another.

Doubtless many feeble-minded children in the community escaped this survey by not being in school at the time of the investigation. We believe, however, that of the children attending school these

examinations have served to discover the ones so poorly endowed that they have to be classed as feeble-minded, and that we have, in the results here offered, indices of the intelligence of the different school districts of this City, as well as an approximately truthful statement of the total number of feeble-minded children amongst these 18,223.

Examination was conducted, for the most part, by the Yerkes-Bridges Point Scale method. Some small children were tested by a Year Scale; a considerable number were measured by both methods. Among the 152 children making a coefficient of mental ability of less than 67 there were only two cases that were not measured by the Yerkes-Bridges Scale. What is rated a coefficient of mental ability in each of these cases was really an intelligence quotient, as Terman uses that term. Likewise among the 244 children making coefficients of mental ability of 67 to 81, inclusive, there were five who dd not have a Point Scale measurement, and for whom we therefore report intelligence quotients. The coefficients of mental ability and the intelligence quotient are not the same mathematical quantities. Because of the very small numbers of intelligence quotients involved we have not eliminated them, or given them separate consideration.

The examinational work was done in twenty-seven schools by Miss Lillian E. Coler; in six schools by Miss Mina A. Sessions; and in five schools by Miss Alida C. Bowler. It was intended to secure the co-operation of the school physician and nurses for physical examination, and of teachers for family histories and social reactions of children. It was not found possible to secure these. The physical examination consisted of conversations with the child and the teacher in supplementing the information obtained by the test, and all such facts were carried to the office and taken into consideration in making the diagnosis. No child was classified as feeble-minded on the basis of his intelligence examinations alone.

Table I shows 157 children reported to the superintendent and principals as feeble-minded, while it exhibits 153 children making coefficients of mental ability of less than 67. We do not consider that any fixed point in the rising scale of coefficients is the point of separation between the feeble-minded and those competent to manage themselves prudently and to profit by ordinary educational facilities. We do believe that the intelligence examination is one important means of making this separation between the

TABLE I

Presenting enrollments of 38 city schools with numbers of children tested in each, numbers and rates of feeble-minded found in each school.

| School | Average enrollment | Number Examined | Number making C. M. A. 67 to 80 | Number making C. M. A. less than 67 | Number reported to Superintendent as Feeble minded | Number ported | Number per 1000 of enrollment reported as Feeble-minded |
|---|---|---|---|---|---|---|---|
| No. 1 | 471 | 20 | 8 | 6 | 5 | | 10.6 |
| No. 2 | 440 | 12 | 5 | 3 | 3 | | 6.8 |
| No. 3 | 416 | 48 | 22 | 6 | 5 | | 12.0 |
| No. 4 | 423 | 13 | 20 | 8 | 7 | | 16.5 |
| No. 5 | 437 | 14 | 4 | 2 | 2 | | 4.6 |
| No. 6 | 530 | 6 | 3 | 2 | 1 | | 1.9 |
| No. 7 | 259 | 7 | 4 | 1 | 1 | | 3.9 |
| No. 8 | 482 | 19 | 6 | 3 | 0 | | 0 |
| No. 9 | 500 | 15 | 10 | 4 | 4 | | 8.0 |
| No. 10 | 426 | 34 | 10 | 12 | 9 | | 21.2 |
| No. 11 | 550 | 32 | 14 | 4 | 4 | | 7.3 |
| No. 12 | 591 | 16 | 2 | 2 | 2 | | 3.4 |
| No. 13 | 418 | 26 | 5 | 11 | 8 | | 19.1 |
| No. 14 | 558 | 7 | 2 | 4 | 3 | | 5.4 |
| No. 15 | 559 | 8 | 0 | 2 | 2 | | 3.6 |
| No. 16 | 673 | 17 | 6 | 5 | 4 | | 5.9 |
| No. 17 | 541 | 16 | 4 | 1 | 2 | | 3.7 |
| No. 18 | 746 | 25 | 6 | 4 | 5 | | 6.7 |
| No. 19 | 526 | 19 | 4 | 1 | 1 | | 1.9 |
| No. 20 | 616 | 9 | 3 | 2 | 2 | | 3.2 |
| No. 21 | 341 | 48 | 16 | 8 | 11 | | 32.3 |
| No. 22 | 634 | 22 | 13 | 4 | 7 | | 11.0 |
| No. 23 | 415 | 34 | 6 | 1 | 1 | | 2.4 |
| No. 24 | 324 | 18 | 3 | 11 | 11 | | 33.9 |
| No. 25 | 464 | 20 | 6 | 5 | 6 | | 12.9 |
| No. 26 | 470 | 14 | 4 | 2 | 3 | | 6.5 |
| No. 27 | 141 | 22 | 8 | 4 | 6 | | 42.6 |
| No. 28 | 384 | 7 | 2 | 1 | 2 | | 5.2 |
| No. 29 | 393 | 13 | 0 | 0 | 0 | | 0 |
| No. 30 | 448 | 36 | 10 | 12 | 14* | | 31.3 |
| No. 31 | 514 | 8 | 1 | 1 | 1 | | 1.9 |
| No. 32 | 716 | 13 | 3 | 1 | 2 | | 2.8 |
| No. 33 | 641 | 15 | 4 | 6 | 6 | | 9.4 |
| No. 34 | 458 | 12 | 3 | 2 | 3 | | 6.5 |
| No. 35 | 332 | 12 | 1 | 0 | 0 | | 0 |
| No. 36 | 446 | 23 | 6 | 8 | 9 | | 20.2 |
| No. 37 | 112 | 16 | 2 | 4 | 5 | | 44.6 |
| No. 38 | 828 | 11 | 0 | 0 | 0 | | 0 |
| Totals | 18,223 | | 707 | 226 | 153 | 157 | 8.6 |

*5 children found feeble-minded by Ohio State University not included

feeble-minded and those who are competent, and the coefficient of mental ability of 67 is about the point where, as we descend in the scale of intelligence, doubt as to mental competence enters. Some children who make coefficients of mental ability of more than 67 must be rated as feeble-minded from the evidence furnished, from moral attitudes, educational, vocational and social facts, or from physical defects. Others who make coefficients of mental ability of less than 67 for similar reasons must be diagnosed as competent to manage themselves prudently and without offense to other members of the community.

Comparison of the numbers reported feeble-minded and the numbers making coefficients of mental ability of less than 67, school by school, exhibits our practice. School No. 10 shows twelve children making a coefficient of mental ability of less than 67, and only nine children were reported feeble-minded; and school No. 21 shows eight children making a coefficient of mental ability of less than 67 and eleven reported feeble-minded. Careful conservatism was exercised in every case. No child was reported to the superintendent and principals as being feeble-minded where any reasonable ground for question or doubt existed.

It will be noticed by observing the totals at the bottom of Table I that 157 children out of 18,223 enrolled, or at the rate of 8.6 per thousand were reported feeble-minded.

The last column of this table giving the numbers per thousand of enrollment found to be feeble-minded, school by school, exhibits most striking variations in prevalence of mental defect in different school districts. There are four schools with an aggregate enrollment of 2040 children in which no feeble-minded child was discovered. Two other schools, No. 27 and No. 37, with 253 enrolled have eleven feeble-minded children, or about 43 per thousand, or 4.3 per cent of the population. Three other schools, No. 21, No. 24, and No. 30, with an aggregate enrollment of 1113 have over 30 feeble-minded children per thousand.

In Table II, the 396 children with coefficients of mental ability ranging from 12 to 81 are distributed according to ages at their last birthdays, and according to the coefficient of mental ability. Of these, 152 were below 66 and 244 from 67 to 81. It is to be observed that some very defective children remain in school beyond the fifteenth year of age, but the maximum number of defectives and near defectives of this group is passed at the tenth birthday. The largest number of children of a given year of age making coefficients

TABLE II

Distribution according to *C. M. A.* and *age* of 396 children making C. M. A. 12 to 81

| Ages | | Coefficients of Mental Ability | | | | | | | | | | | Totals by Ages | Coef. of M. A. | | | Totals by Ages | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12 to 16 | 7 to 21 | 22 to 26 | 27 to 31 | 32 to 36 | 37 to 41 | 42 to 46 | 47 to 51 | 52 to 56 | 57 to 61 | 62 to 66 | 12 to 66 | 67 to 71 | 72 to 76 | 77 to 81 | 67 to 81 | 12 to 18 |
| 6 | years | | 1 | | | | | | | | | 1 | 2 | 4 | 4 | 2 | 10 | 12 |
| 7 | years | | | | | | | 1 | 3 | 3 | 4 | 2 | 13 | 5 | 8 | 5 | 18 | 31 |
| 8 | years | 1 | | | 1 | | | | 2 | 2 | 2 | 7 | 15 | 2 | 6 | 4 | 12 | 27 |
| 9 | years | | | | 1 | | 4 | 1 | 5 | 2 | 6 | 5 | 24 | 2 | 10 | 14 | 26 | 50 |
| 10 | years | | | 1 | 1 | | | | 2 | 1 | 7 | 7 | 19 | 7 | 9 | 12 | 28 | 47 |
| 11 | years | | | | | 3 | | | 1 | 7 | 3 | 3 | 17 | 15 | 9 | 10 | 34 | 51 |
| 12 | years | | | | 1 | | 2 | 2 | | | 5 | 8 | 18 | 15 | 10 | 13 | 38 | 56 |
| 13 | years | | | | | | 1 | | 3 | 4 | 3 | 5 | 16 | 6 | 9 | 12 | 27 | 43 |
| 14 | years | | | | | 1 | 1 | | 1 | 3 | 5 | 4 | 15 | 6 | 7 | 12 | 25 | 40 |
| 15 | years | | | | | 1 | | | | 2 | 3 | 6 | 12 | 5 | 10 | 3 | 18 | 30 |
| 16 | years | | | | | | | | | | | 1 | 1 | 2 | 3 | | 5 | 6 |
| 17 | years | | | | | | | | | | | | | 1 | | 2 | 3 | 3 |
| Totals | | 1 | 1 | 1 | 4 | 5 | 8 | 4 | 17 | 24 | 38 | 49 | 152 | 70 | 85 | 89 | 244 | 396 |

of mental ability of less than 67 is at nine years where there are 24 children. Still it will be observed that out of the 152 making these low coefficients of mental ability 98, or nearly two-thirds of the whole number, are more than nine years of age. Large numbers of feeble-minded children are allowed to clog the machinery of a regular school and impair the progress of the normal child. This is particularly true in the tenth, eleventh, and twelfth years of age.

TABLE III

Distribution according to *C. M. A.* and *School Grade* of 396 children making C. M. A's 12 to 81.

| School Grade | Coefficients of Mental Ability | | | | | | | | | | | Totals C. M. A. | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 to 16 | 17 to 21 | 22 to 26 | 27 to 31 | 32 to 36 | 37 to 41 | 42 to 46 | 47 to 51 | 52 to 56 | 57 to 61 | 62 to 66 | 12 to 71 | 67 to 76 | 72 to 81 | 77 to 81 | 67 to 81 | 12 to 81 |
| Special | | | | | 1 | | | | 1 | 2 | 4 | 8 | 3 | 4 | 9 | 16 | 24 |
| I | 1 | 1 | 1 | 3 | 2 | 4 | 3 | 9 | 7 | 9 | 10 | 50 | 11 | 16 | 8 | 35 | 85 |
| II | | | | 1 | | 1 | 1 | 3 | 4 | 13 | 10 | 33 | 6 | 14 | 14 | 34 | 67 |
| III | | | | | | 3 | | 2 | 5 | 6 | 9 | 25 | 14 | 13 | 11 | 38 | 63 |
| IV | | | | | 1 | | | 3 | 5 | 3 | 7 | 19 | 19 | 14 | 24 | 57 | 76 |
| V | | | | | 1 | | | | 2 | 4 | 7 | 14 | 11 | 14 | 9 | 34 | 48 |
| VI | | | | | | | | | | 1 | 1 | 2 | 5 | 8 | 9 | 22 | 24 |
| VII | | | | | | | | | | | 1 | 1 | 1 | 1 | 4 | 6 | 7 |
| VIII | | | | | | | | | | | | | | 1 | 1 | 2 | 2 |
| | 1 | 1 | 1 | 4 | 5 | 8 | 4 | 17 | 24 | 38 | 49 | 152 | 70 | 85 | 89 | 244 | 396 |

In Table III the children making the same coefficients of mental ability (396 children) are distributed by the grades in school making them at the times of examination and by the coefficients of mental ability. The maximum number in single year of school is found in the second grade where there are 50 with coefficients of less than 67, and 35 with coefficients between 67 and 81. This is also de cidedly the maximum number of the former group, the next largest number being found in the third grade (33). Both morons and dullards *accumulate* in grade two, and both groups clog the machinery of grades three to five. Relatively small numbers of feeble-minded children are allowed to pass grade four.

TABLE IV

Distribution of the 152 children making C. M. A's of less than 67 by *age* and school grade.

| | 6 yrs. | 7 yrs. | 8 yrs. | 9 yrs. | 10 yrs. | 11 yrs. | 12 yrs. | 13 yrs. | 14 yrs. | 15 yrs. | 16 yrs. | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Special | | | | | 1 | | 1 | 2 | 1 | 3 | | 8 |
| Gr. I | 2 | 12 | 12 | 14 | 4 | 4 | 1 | | 1 | | | 50 |
| Gr. II | | 1 | 3 | 9 | 8 | 4 | 6 | 2 | | | | 33 |
| Gr. III | | | | 1 | 6 | 6 | 7 | 2 | 3 | | | 25 |
| Gr. IV | | | | | | 2 | 1 | 8 | 4 | 4 | | 19 |
| Gr. V | | | | | | 1 | 2 | 2 | 6 | 3 | | 14 |
| Gr. VI | | | | | | | | | | 2 | | 2 |
| Gr. VII | | | | | | | | | | | 1 | 1 |
| Totals | 2 | 13 | 15 | 24 | 19 | 17 | 18 | 16 | 15 | 12 | 1 | 152 |

Table IV presents the distribution by age and grade of the 152 children making coefficients of mental ability of less than 67. This Table exhibits the slow resort to the special school and special room for even the feeble-minded child, and it exhibits the omnipresent tendency to push the feeble-minded on to higher grades where the seats will accommodate their growing bodies, even though they cannot profit by their experiences in the advanced room. In fact an indefinite hope that the child can find some means of growth in some other teacher mingles, in the mind of principal and teacher, with the desire to be rid of the *impediment* which the feeble-minded child constitutes. It is the school's business to prepare the child for promotion and to promote him. The feeble-minded child for whose socialization the mechanism of the school is poorly arranged falls a victim to the machine and he is promoted mechanically, just as if he were socialized and ready to move on.

These feeble-minded children are from one to six years behind the grades expected for their ages. There is observable, however, even allowing for the talents they do possess, or rather their distinct lack of talent, a positive tendency to advance them in school work, in which work they are making no real progress. To any one who is familiar with the eight year old mind trifling with the school room activities of the fifth grade, the facts presented in Table IV indicate a striking misapplication of educational forces in the schools of this City. Such a person realizes what a draw-back the presence of these 152 children is in these schools; how they hinder the bright

boy and girl by taking undue energy of the teacher, all to no purpose; how they fatigue and exasperate the teacher; and how they themselves fret and reap no benefit from the procedure. Such persons know that the presence of these defective children, these non-potential citizens in the public schools is a positive waste of social substance. This waste is just as real as that of the food profiteer who allows a cargo of potatoes to rot on the pier in order to keep prices up.

Such an intelligence survey of a City school population is most valuable in indicating the different levels of intelligence of various parts of the population of the City. It affords indispensable information for the intelligent planning of the education, or preparation for citizenship, of the different parts of a city population. Educational work must be adapted to the needs of the individual. We have not given so much attention to the necessity of adapting the work of character building to different wards and precincts of a city. We must take the situation as it exists in the group for whose service the school is provided in order to make citizens of the children of that group. Figures from different school districts such as this study supplies afford one of the necessary bases upon which such intelligent planning of educational work, school, by school, must be founded. All social upbuilding will find similar profit in consulting such data. Doubtless the applications of psychology to community service will be greatly broadened in the near future. We shall have more elaborate means of analyzing the potentialities of citizenship in the individual. For the present, however, this is no argument for neglecting the very useful information which applied psychology is placing in the hands of the community builder. Such figures on intelligence measurements are an indispensable part of any school survey which looks to the more fruitful application of educational forces to character building in a community and to the development of a better democracy.

# THE RANGE OF INFORMATION IN BIOLOGY III. BOTANY*

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## I. INTRODUCTORY

IN the preceeding paper of this series (1), it was pointed out that the most closely related predecessor of secondary biology was probably the nature study of the grades, since it seems that the larger portion of nature study as taught at present consists of extremely elementary zoology and botany. The viewpoints disclosed by the range of information test in the courses of physiology and zoology have been discussed in the two previous papers, ( 1-2), and of the components of nature study which we have recognized, there remains only botany to treat in a similar manner.

Further insight as to the amount of botanical knowledge pupils carry with them into the high schools seems desirable for a number of reasons. Botany in the first place shares with the other secondary biological sciences the condemnation implied by a decline in the number of students taking them in recent years, as pointed out by Downing (3). Leading botanists are inclined to attribute this situation to the want of effective teaching (4). Under ordinary circumstances, one could consistently take the standpoint that, since no form of life is more abundant than plants and none so important, there should be no insuperable difficulty in making the teaching of such a science effective. That there has been some comprehension of this advantage is shown by the variety of textbooks on hand, apparently adapted to every type of locality in which botany is given. Textbooks dealing with some applied form, such as agriculture, are available for rural districts where they are more likely to be desired; for cities and larger towns, where often more purely cultural values seem to be rated higher, there are others colored with the philosophical aspects of botany, such as plant ecology.

*The writer is indebted to the authorities of the St. Louis Schools, Prof. J. A. Drushel, Harris Teacher's College, Dr. G. M. Holferty, Central High School, St. Louis, for aid in furthering this investigation.

To the best of the writer's knowledge no textbook of botany in use at this time takes into serious consideration any previous knowledge of botany gained from the nature study of the grades. There may be adequate reason for this. Nature study is to a great extent synonomous with natural history, but so far as instruction goes the natural history of plants seems on the whole comparatively neglected when compared with that of animals, as parts of it, such as the complicated life cycles of certain groups of plants, seem too difficult for pupils of an early age. It would be fair to assume that botany has gravitated to its present place in the older type of high school on account of being more closely related to the interests of the pupils at least, if not on account of any relation with nature study. The course in nature study, however, constantly tends to include more botanical knowledge within its scope, and the existing bond between it and botany is being strengthened. Those interested in the effective teaching of high school botany should take account of this fact, and may well inquire to what extent the ground has been broken by nature study. Such has been the effort of the writer based on the range of information test (5).

## II. Method

The 100 test words were selected in the following manner: A list was first prepared of all the words pertaining directly to botany in the spellers and readers previously used by the pupils in their grade school work. A similar list was made from Boy Scout and Camp Fire girls publications. From these lists, 100 of the more frequently occurring words were checked, those chosen being:

1. Words in fairly common use, a knowledge of which would indicate the range of information of those phases of plant life the pupils might be expected to know about from their nature study, school gardens, etc.
2. Words, a knowledge of which would indicate some familiarity with biological principles, and the relation of plants to lower animal groups as well as to man.

Since the method of giving the test has been discussed in previous papers there is given here only the list of words used. It need only be said that in giving the test the pupils were told how the terms were selected and that they pertained directly or indirectly to plants.

## III. Results

The results are found in the following tables. By first term students is meant those taking up the study of botany at the time. Second term students have just finished botany and are beginning physiology. It may be well to remark that as a check on the original marking of the pupils, (first series), the 100 words were defined from the glossaries of textbooks containing the words, and each pupil revised his own paper by placing a "second series" of marks after each word, indicating the manner in which he should have marked it. A comparison of the D's, E's, F's, N's, of the first and second series, besides showing fairly accurately the extent and nature of the error due to ignorance or misunderstanding of the real meaning, gives a rough preliminary measure of the extent to which these 100 terms are understood by first year high school pupils.

TEST WORDS

| | | | |
|---|---|---|---|
| absorption | crown | mould | seed leaf |
| alternate bud | desert | nectar | seedling |
| alternate branch | digestion | nitrogen | sepal |
| alternate flower | energy | nut | sheet |
| animal | evergreen | opposite bud | shrub |
| anther | fermentation | opposite branch | spines |
| bacteria | fern | opposite flower | spray |
| bark | fertilizer | oxygen | stalk |
| berry | fibers | parasite | stamen |
| biennial | fibrous root | perennial | starch |
| blade | floret | petal | stem |
| blight | flower | pistil | stigma |
| branch | foliage | pith | swamp |
| bud | fruit | plantation | tap-root |
| bulb | fungus | pod | tassel |
| cactus | gall | pollen | tendril |
| calyx | germinate | proteid | terminal bud |
| carbohydrate | grain | ray | trunk |
| carbonic acid gas | herb | resin | tuber |
| cell | leaf | reproduction | twig |
| coal | leaflet | ripe | vegetable |
| composite | legume | rootlet | veins |
| corolla | meadow | rosette | vine |
| cork | migration | sap | woods |
| cross | moss | seed coat | yeast |

TABLE I

DEPENDENCE OF RANGE OF INFORMATION ON ACADEMIC STATUS

A

(1st series)

| Academic status | No. | D | E | F | N | % Error |
|---|---|---|---|---|---|---|
| 1st term pupils | 97 | 22.86 | 19.67 | 19.99 | 37.07 | |
| 2nd term pupils | 86 | 32.4 | 31.70 | 20.70 | 15.05 | |

B

(2nd series)

| Academic status | No. | D | E | F | N | %Error |
|---|---|---|---|---|---|---|
| 1st term pupils | 97 | 26.84 | 25.25 | 20.05 | 26.64 | 4.7 |
| 2nd term pupils | 86 | 39.96 | 31.72 | 16.32 | 11.64 | 3.84 |

Table I, A & B, shows that with maturity there is a decided increase in the number of terms that can be defined, (D), explained, (E), with a corresponding decrease in the number of new terms, (N). In the preceding two papers of the series, the greatest increase was found to be in the number of F's. Here they are practically equivalent in the first series, and are found to diminish in the second. In both grades of pupils, checking up as a whole increases only the D's, and diminishes only the N's; the E's are increased only in the first term pupils, whereas in the preceding two papers it was found that the E's increased and the F's decreased in both.

A very short period of time elapsed between the completion of the botany course by the second termers and the taking of the test. While studying botany they came in contact with most but not all of the test words. This of course would explain their marked superiority, greater accuracy of definitions in D's and E's, both series. The botanical part of nature study courses is, of course, not as highly organized as the botany courses of the high schools, and the difference between the number of D's and E's of the 1st and 2nd termers is illustrative of the difference between pursuing the regular, organized study of a subject and pursuing it sporadically without constant supervision. Completion of the former type of course may be inferred to leave an ability to define or explain more words pertaining to it, while to a student of the latter type, there are more words which are merely familiar or even new. In

the first type of study ability to define exceeds ability to explain (as shown in the 2nd series), while in the second type of course these abilities are practically equal.

That the E's have not increased in the second series is probably accidental. It is likely that the same words were marked similarily in both series on both sides, but more probable that some of the E's of the first series have been displaced into D's in the second at the eventual expense of the F's and N's. There is thus a shifting forward of the values of D's and E's. The same situation is found in F's of the 1st termers and may be similarily explained. From this one may conclude that to the student untrained in botany 20% of the representative terms are generally familiar, while the trained student may explain 31% rather than merely know them. Discriminatory power in students has advanced as shown by the percentage of error, 4.7% in the first termers, and 3.84% in second termers. This of course is due to the more constant supervision of organized class room work, especially trained teachers, etc.

The D's were more numerous and the N's were fewer in the botany test than in either of the preceding tests, physiology (1) and zoology (2), possibly because illustrative material is more abundant in botany. This may also account for the lowest percentage of error in it of all three subjects, and may be taken as an indication that *high school botany as a subject has the best basis of all the biological subjects upon which to build, and probably more elementary botany could safely be included in the course of nature study. With such an aid to effective teaching there would seem to be no excuse for its failure to persist in the curriculum.*

TABLE II

DEPENDENCE OF RANGE OF INFORMATION ON SEX

A

(1st series)

| Academic status | No. | D | E | F | N | %Error |
|---|---|---|---|---|---|---|
| High School Boys | 101 | 31.88 | 24.18 | 18.42 | 25.03 | |
| High School Girls | 82 | 23.38 | 27.2 | 22.28 | 27.39 | |

B

(2nd series)

| Academic status | No. | D | E | F | N | %Error |
|---|---|---|---|---|---|---|
| High School Boys | 101 | 34.27 | 26.49 | 16.68 | 21.95 | 7% |
| High School Girls | 82 | 32.58 | 30.48 | 19.79 | 17.42 | 6% |

Reclassified by sex, the results of the rest show a slight superiority in girls of range of information in nature study. This somewhat substantiates the old tradition of botany being a "girls' school subject." Another conclusion derived is the same as that taken from the paper on zoology: That these particular concepts are clearer with boys than girls, regardless of what boys may retain. This checks with the percentage of error, 2 per cent with boys, 7 per cent with girls. It was previously found that the boys showed a greater range of information in physiology, but it seems that the girls excel in nature study as shown by this and the paper on zoology. The percentage of error is practically the same as in the latter paper, 2% in boys, 6% in girls, the same as that obtained in both parts of the succeeding tables. When these are compared with physiology —5% and 8%, one may infer that the latter is a more difficult subject for pupils.

TABLE III

A

(1st series)

| Academic status | No. | D | E | F | N | %Error |
|---|---|---|---|---|---|---|
| 2nd term High School Boys | 54 | 42.86 | 29.48 | 14.29 | 12.67 | 2% |
| 2nd term High School Girls | 32 | 25.4 | 33.3 | 24.2 | 17.1 | 7% |

B

(2nd series)

| Academic Status | No. | D | E | F | N | %Error |
|---|---|---|---|---|---|---|
| 2nd term High School Boys | 54 | 42.86 | 29.48 | 14.29 | 12.67 | 2% |
| 2nd term Hgh School Girls | 32 | 37.06 | 33.96 | 18.34 | 10.61 | 7% |

The insight afforded by a mixed classification by sex and academic status is presented in Table III, A. B. C. D. Second term boys secured a greater percentage of D's in both series. Girls show a great number of E's and F's and in the second series a small number of N's. The percentage of errors in girls was 6%, in boys 2%. The results differ from that secured in zoology, in that the second term boys know more than girls and in addition have clearer ideas.

TABLE III

DEPENDENCE OF RANGE OF INFORMATION ON SEX AND ACADEMIC STATUS

(1st series)

| Academic status | No. | D | E | F | N | % Error |
|---|---|---|---|---|---|---|
| 1st term High School Boys | 47 | 24.36 | 18.25 | 19.63 | 37.06 | |
| 1st term High School Girls | 50 | 21.37 | 21.1 | 20.36 | 37.68 | |

D

(2nd series)

| Academic status | No. | D | E | F | N | %Error |
|---|---|---|---|---|---|---|
| 1st term High School Boys | 47 | 25.68 | 23.5 | 19.10 | 31.23 | |
| 1st term High School Girls | 50 | 28. | 27. | 21.23 | 24.23 | |

The tables dealing with first term boys and girls show that the range of information is practically equivalent in both in the first series, while the girls are generally superior in the second. Girls are superior throughout in E's and F's; they were found superior in E's in zoology, but with a greater percentage of error. To offset this apparent lack of range of information, the boys show less percentage of error, 2% against 6%.

A list of typical errors of definition follows in which the words that are apparently the source of confusion are indicated in parenthesis. The list as formulated does not have the wide range of those given in the preceding papers, possibly because as already stated botanical objects are the more familiar ones and are therefore more easily defined or explained.

Absorption—to drink; taking in bread and water; evaporating; to dry up.
Alternate bud—a bud that keeps in touch with another bud running together.
Bacteria—little animals; germs found in plants and animals.
Bark—material a tree is made of.
Berry—fruit of certain trees; a little bud that grows on a bush.
Biennial—a plant which blooms twice a year, (semi-annual); half yearly.
Blade—part of a plant.
Blight—to kill a plant by cold or frost.
Bud—beginning of a tree or flower; a baby flower before opening; an undeveloped plant.
Bulb—part of a flower; a root leaves spring from; a pod which contains flowers and roots; a plant which gets all its nourishment from water.
Cactus—grows in a desert.
Carbohydrate—a fat for a body; given off from the body carbon dioxide.
Cell—place where seeds are found; a bacteria; small place in a flower.
Fern—a flower which does not have buds.
Grain—fruit which we can eat.
Petal—part of a tree.
Pith—kind of powder inside a twig.
Shrub—a low flower.

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# COMMUNICATIONS AND DISCUSSIONS

## SUGGESTIONS WITH REGARD TO PROFESSOR THURSTONE'S "METHOD OF CRITICAL SCORES"

THE writer was much interested in Professor Thurstone's vigorous demand, in a recent article in this Journal [1] for a greater consideration of the practical problems of individual diagnosis, in evaluating mental tests. The few comments below are intended not as criticism of Professor Thurstone's methods, but rather as an effort to carry his general plans still further than he has done.

In the first place, if a group of tests is to be used for the purpose of prognosticating failure in college why not evaluate the tests directly according to their ability to do this, – – instead of by the more round-a-bout comparison of their agreement with instructors estimates of ability? Various rough and ready methods for measuring the "efficiency" of a test in differentiating the extremes of a group are possible. The writer has recently been working over some results from a large sixth grade class in Junior High School, with a brief group scale of intelligence, in order to compare the differential value of the tests of this scale in distinguishing those pupils who failed at the end of the school year. The method used is extremely simple and straightforward. The results for the sixth grade on each test had been already tabulated. At the end of the year the writer simply obtained from the school a list of the failures and marked the score of each one of these children over in red ink. This, in itself, gave a rough picture of the situation; the extent to which the red marks of the failures were found well up among the pencil marks indicating the scores of those who passed in their work for the year showed the extent to which the particular test in question failed to differentiate the failures from the successful children. A numerical statement of differential power was obtained simply by counting the number of pencil marks below each red mark, – – that is, the number of successful children which the test failed to distinguish from each particular failure – – and averaging the results for all the red marks, for each test. This final average gave the "average error" which, expressed in percent, gave a "percent of error" for each test. The method has been described more fully elsewhere [2], and need not be further detailed here.[3] As illustrative

[1] Thurstone, L. L. Tests for College Freshmen, *Journal of Educational Psychology*. Vol. 10, pp. 129-92, March 1919.

[2] Pressey, S. L. and L. W. The Practical "Efficiency" of a Group Scale of Intelligence, *Journal of Applied Psychology*. Vol. 2, pp. 68-80, Mazch 1919. A preliminary description of the "Cross-out" scale, from study of which the illustrative material of the present brief paper has been drawn, appeared in the June number of the same journal; a final statement will be published shortly.

[3] The further point should be mentioned, however, that although the method weights, heavily, marked discrepancies between test finding and the independent criterion it does not, as does the "method of critical scores" put the situation altogether at the mercy of the single extreme deviate score.

of the general run of the figures to be expected it may be said shortly that the writer's tests have shown from four to twelve per cent error in differentiating failures.

(2) A second suggestion has to do with the form that the recommendation to the school authorities, based on the test findings, should take. Professor Thurstone tells us that "Those students are reported as doubtful who attain a median percentile rank of 22% or below, and who are below the lower critical score on two or more of the six tests" (p. 136). But an administrative officer would surely be interested to know the degree of doubtfulness implied in this statement. He might also wish to know what inference might be drawn from a score at the five percentile or at the twenty-five percentile. A method which gives an exact statement of the probability of failure implied by a score at any point in the distribution may be illustrated by further treatment of the results from the "Cross-Out" scale above mentioned; results are again from the sixth grade, (156 cases). The tests were given at the beginning of a semester: at the end a list of the failures was obtained, as stated above, and also a list of children who were considered by at least three out of the four teachers in the four promotion subjects, to be doing brilliant work. There were 14 children doing exceptional work and 13 complete failures (children who failed in four or more subjects). The scores of the failures were marked in on the distribution of the total scores for the entire grade in red ink; the scores of the brilliant children in black ink. The deciles for the whole distribution were now calculated, and the number of failures and of brilliant children scoring in each tenth of the distribution noted and expressed as a percent of the total number in the division. The final result was the following table of probabilities:

TABLE I

| Decile divisions | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Percentage Probability that case will fail | 47 | 13 | 20 | 7 | 7 | 0 | 0 | 0 | 0 | 0 |
| Percentage probability that case will do brilliant work | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 20 | 20 | 47 |

For use in individual diagnosis such a table should be read: if a given child in the sixth grade, at the first of the semester, scores in the lowest tenth of his class, there is a 47% probability that he will be a complete failure at the end of the year; if he scores in the second decile division, there is a 13% probability etc. for the other divisions. The second line is read similarly for prognosis of brilliant work. The above figures are of no great importance as they deal with prognosis based on a relatively few cases, over a short period of time, but the method would appear to have some general application.

(3) Professor Thurstone very correctly points out the inadequacy of the correlation coefficient in giving information with regard to the ability of a test to differentiate extreme cases. However, the problems of individual diagnosis may also arise with regard to cases around the average in ability, – – as in making up "fast," "medium" and "slow" sections in Junior High School. A way in which a scatter diagram may be thrown into a simple form readily interpretable by psychological laymen, for purposes of individual prognosis in such situations, is given below. The basis of the calculations was a correlation table for the sixth grade, showing the relationship between test scores and pooled ratings of each pupil's general ability obtained, by use of a rating scale, from four teachers. The ratings were made in June after the teachers had had a year of acquaintance with the children. This table was divided into 25 parts by drawing lines through the 20, 40, 60, and 80 percentiles on both distributions; the table was thus divided each way into five sections, not equal in size on the plotting paper, but equal in having the same number of cases. It was then summarized to read for 100 cases, twenty in each of the five vertical, and twenty in each of the five horizontal divisions. The results are given in table II; 1 is high and 5 low in each distribution.

TABLE II

| Division into fifths according to test scores | Division into fifths according to teachers' estimates:— | | | | |
|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 |
| 1 | 0 | 1 | 1 | 6 | 12 |
| 2 | 2 | 3 | 4 | 5 | 6 |
| 3 | 3 | 5 | 6 | 5 | 1 |
| 4 | 5 | 5 | 6 | 3 | 1 |
| 5 | 10 | 6 | 3 | 1 | 0 |

The table is to be read as follows(supposing the scale to have been given to a sixth grade at the beginning of a semester for the purpose of obtaining a prognostication as to ability each child will have shown at the end of the semester). If a given child scores below the 20 percentile, the probability is 10 out of 20 that he will be considered by the teachers, after a year's acquaintance, to belong in the poorest fifth of the class as regards ability; there are 6 chances out of 20 that he will be considered in the second fifth; there is only one chance out of 20 that he will be considered above the third, or average, group. If the pupil tests as in the middle fifth of the class, the chances are 3 out of 20 that he will be judged in the poorest fifth, and one out of 20 that he will be judged in the best fifth, – – and so on.

As methods of presenting test data for use in individual diagnosis these two tables have the practical advantages that (1) they are readily understood, (2) the practical implication of the test findings is direct and unmistakeable, (3) an exact statement of the definiteness of that implication, for any case, is given.

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[4] It has been outlined in a somewhat different way in a previous article. Irregularity on a Psychological Examination as a Measure of Mental Deterioration: *Journal of Abnormal Psychology*. December, 1918.

## THE RELATION OF SCHOLARSHIPS TO THE YERKES AND TERMAN ADULT TESTS

During the present collegiate year, students taking courses in Psychology and Education were tested by both the Yerkes-Rossy* adolescent-adult point scale and the Terman adult tests, by the group method. No freshmen are admitted to these classes. The results have been tabulated for the other three classes separately and for the Juniors and Seniors combined as the two latter classes take very nearly the same collegiate work. An Extension class of teachers, the majority of whom had taken 2-4 years of college work and in addition had much experience in teaching, were also given these tests. Two small classes of high school Juniors and Seniors took the Yerkes-Rossy tests. Thus there was here opportunity to compare scholastic performance with intelligence rating by two scales and also note possible diagnostic values of the different exercises.

The following tables give the mean and mean variation of each of these groups for each of the twenty exercises of the Yerkes-Rossy scale.

*Yerkes and Rossy, A Point Scale For the Measurement of Intelligence, Boston Medical and Surgical Journal CLXXVII, 564-573.

| 50 Sophomores | | | 50 Seniors | | 81 Jun.-Sen. | | 131 Students | | 17 Teachers | | Total 148 | High School | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test | Mean | M. V. | Mean | M. V. | Mean | M. V. | Mean | M. V. | Mean | M. V. | Mean | Mean | M. V |
| 1 | 6.80 | 1.1 | 7.16 | 1.03 | 7.10 | 1.58 | 7.00 | 1.07 | 7.60 | .59 | 7.06 | 6.15 | .68 |
| 2 | 3.0 | 0.0 | 3.0 | 0.0 | 3.0 | 0.0 | 3.0 | 0.0 | 3.00 | 00 | 3.0 | 2.84 | .15 |
| 3 | 3.16 | .86 | 3.56 | .99 | 3.57 | .85 | 3.53 | .85 | 3.40 | .97 | 3.52 | 3.02 | .80 |
| 4 | 3.34 | 1.04 | 3.90 | .66 | 3.90 | .72 | 3.70 | .84 | 4.30 | .43 | 3.77 | 3.13 | 1.01 |
| 5 | 3.96 | .74 | 3.94 | .56 | 3.90 | .59 | 3.91 | .64 | 3.80 | .45 | 3.90 | 3.20 | .68 |
| 6 | 4.88 | 1.01 | 5.30 | .80 | 5.27 | .82 | 5.11 | .88 | 5.70 | .43 | 5.20 | 4.59 | 1.18 |
| 7 | 4.28 | .56 | 4.38 | 1.16 | 4.45 | .61 | 4.39 | .60 | 4.64 | .46 | 4.42 | 3.72 | .85 |
| 8 | 6.12 | 1.20 | 6.50 | 1.15 | 6.43 | 1.00 | 6.31 | 1.08 | 7.30 | .77 | 6.43 | 5.43 | 1.40 |
| 9 | 4.19 | .18 | 4.90 | .18 | 4.91 | .15 | 4.91 | .16 | 4.90 | .19 | 4.91 | 4.56 | .56 |
| 10 | 4.80 | 1.54 | 5.54 | .80 | 5.23 | .88 | 5.07 | .77 | 6.00 | 0.0 | 5.18 | 4.61 | 1.00 |
| 11 | 3.68 | .48 | 3.80 | .33 | 3.84 | .20 | 3.76 | .31 | 3.80 | .18 | 3.79 | 3.66 | .45 |
| 12 | 5.44 | 1.57 | 5.86 | 1.10 | 5.94 | .64 | 5.74 | 1.26 | 7.53 | 1.09 | 5.95 | 5.15 | 1.62 |
| 13 | 3.22 | .84 | 3.42 | .76 | 3.47 | .26 | 3.37 | .80 | 3.76 | .47 | 3.54 | 2.33 | 1.28 |
| 14 | 1.86 | 1.04 | 3.72 | 2.45 | 3.80 | 2.48 | 3.06 | 2.44 | 5.20 | 2.06 | 3.31 | 1.00 | 1.48 |
| 15 | 1.54 | .58 | 1.28 | .69 | 1.38 | 35 | 1.44 | .64 | 1.47 | .56 | 1.44 | 1.05 | .72 |
| 16 | 3.48 | 2.10 | 3.88 | 2.05 | 3.74 | 2.09 | 3.64 | 2.07 | 4.30 | 1.60 | 3.71 | 2.90 | 1.97 |
| 17 | 1.52 | .67 | 1.68 | .51 | 1.74 | .41 | 1.66 | .52 | .47 | .72 | 1.52 | 1.67 | .51 |
| 18 | 1.34 | 1.42 | 1.58 | 1.39 | 1.50 | 1.40 | 1.43 | 1.44 | 3.41 | .90 | 1.66 | 1.23 | 1.39 |
| 19 | 1.80 | .32 | 1.84 | .26 | 1.84 | .27 | 1.82 | .29 | 1.82 | .29 | 1.82 | 1.95 | .09 |
| 20 | 3.60 | .59 | 3.65 | .55 | 3.50 | .68 | 3.54 | .65 | 3.94 | .11 | 3.59 | 3.71 | .45 |
| Total | 72.82 | 6.87 | 78.76 | 6.06 | 78.70 | 6.44 | 76.42 | 6.16 | 87.50 | 3.88 | 77.72 | 66.23 | 6.71 |

It is apparent from these results that this group of 50 college seniors obtained lower averages than those of the college women reported by Yerkes and Burtt in exercises 5, 7, 12, 13, 16, 18, and somewhat higher in exercises 1, 4, 8, 14, 17. The averages of all these 148 college women are lower than those given by Yerkes and Burtt for tests, 5, 10, 12 13, 16, 18, and a little higher for tests 1, 6, 7, 8, where some of the discrepancy may be due to differences in scoring. The total averages are on the whole very similar, tho somewhat higher for these seniors. It is interesting, if not significant that the 17 teachers of the Extension class exceeded the men's scores for tests 14 and 18; as well as their general average.

Another interesting comparison with the results of Yerkes and Burtt* is in the distribution of point-scale scores, as can be seenfrom the following table which gives the percentages of each group.

TABLE II

| Scores | 50 Seniors | 31 Juniors | 50 Sophomores | 17 Teachers | 148 Total | 39 High Sch. Jun.-Sen. |
|---|---|---|---|---|---|---|
| 40–49 | ..... | ..... | 2.0% | ..... | .6% | 2.5% |
| 50–54 | ..... | ..... | ..... | ..... | 0.0% | 7.7% |
| 55–59 | ..... | 3.0% | 4.0% | ..... | 3.3% | 10.2% |
| 60–64 | 4.0% | 3.2% | 14.0% | ..... | 6.7% | 25.1% |
| 65–69 | 8.0% | 6.4% | 8.0% | ..... | 6.7%. | 7.7% |
| 70–74 | 14.0% | 16.1% | 22.0% | ..... | 15.5% | 33.3% |
| 75–79 | 28.0% | 25.8% | 32.0% | 11.7% | 27.0% | 10.2% |
| 80–84 | 20.0% | 19.6% | 16.0% | 5.8% | 16.9% | 2.5% |
| 85–89 | 20.0% | 16.1% | 0.0% | 41.1% | 14.8% | ..... |
| 90–94 | 6.0% | 9.7% | 2.0% | 35.3% | 8.8% | ..... |
| 95–100 | ..... | ..... | ..... | 5.8% | .6% | ..... |

*Yerkes and Burtt, Relation of Point Scale Measurements to Educational Performance, School and Society, V, 535-540.

The percentages of the upper scores are larger than those obtained for the women at Harvard, and the distribution of the entire college group of 148 women compares favorably with that obtained for their men, except at the lower end. The one student whose score fell below 50 has been asked not to return on account of poor scholarship. The conspicuous feature of the distribution of these scores is that it conforms so regularly to the expected distribution of scholarship of the different groups.

In order to estimate the diagnostic value of each of the twenty exercises the percentages of the maximum score of each one obtained by the high school students were compared with those of the college seniors and of all the college students. According to this comparison, the scores of the high school girls were equal to or slightly better than those of the college students in tests 2, 11, 17, 19, 20 and 7% lower in exercise 9, and from 10% to 15% lower in tests 1, 3, 4, 5, 6, 7, 8, 10, 12, 15, 16, 18, while in tests 13 and 14 they were 30% and 37% lower respectively. A similar comparison between the 50 college seniors and the 50 sophomores showed that the scores of the former averaged 5% to 10% higher in exercises 4, 6, 10, 12, 13, 16, 17, 18, in test 14 over 26% higher, but in test 15, 13% lower, and that the average scores for the other exercises were almost equal. Hence, tests 2, 11, 19, and 20 seem of doubtful value for differentiating groups of the kind here examined.

With a few exceptions, due to changes in classes, the same college students took the Terman tests for years XIV, XVI, XVIII, and the teachers in the Extension class were given all the adult tests. The percentage of each of these groups that passed each of the tests is shown in the following table:

TABLE III

| Terman Tests | XII | XIV | | | | | XVI | | | | | XVIII | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 2 | 3 | 4 | 5 | 6 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| 48 Seniors | 85.4 | 77.0 | 91.6 | 83.3 | 87.5 | 83.3 | 93.7 | 89.5 | 95.8 | 89.5 | 68.7 | 1.00 | 58.3 | 60.4 | 83.3 | 58.3 | 45.8 |
| 44 Juniors | 81.8 | 68.1 | 86.3 | 81.8 | 84.0 | 59.0 | 97.7 | 81.8 | 79.5 | 77.2 | 70.6 | 1.00 | 50.0 | 63.6 | 90.9 | 65.9 | 68.1 |
| 48 Sophomores | 77.0 | 79.1 | 85.4 | 87.5 | 87.5 | 83.3 | 97.9 | 89.5 | 85.4 | 85.4 | 85.4 | 1.00 | 64.5 | 31.2 | 87.5 | 52 0 | 22.9 |
| 17 Teachers | 29.4 | | | | | | 1.00 | 1.00 | 1.00 | 94.1 | 1.00 | 1.00 | 1.00 | 58.8 | 88.2 | 58.8 | 94.0 |
| 140 Students | 81.4 | 7.50 | 87.8 | 84.3 | 86.4 | 75.7 | 96.4 | 87.1 | 87.1 | 84.3 | 75.0 | 1.00 | 57.8 | 51.4 | 87.1 | 58.5 | 45.1 |

It is evident from these results, that for these teachers the Ball-Field test was much more difficult than any of the others, and that the repetition of the digits was a much harder task than the Binet Paper-Cutting and the Ingenuity tests. The scores of the college students show that with exception of the vocabulary and Logical Memory tests, the XVIII year exercises are the most difficult, tho the clock problem is the next hardest test for the Juniors. These students found the Induction, the Code, and the Clock problems second in difficulty to the four of year XVIII. Unless a perfect score is required, the Fables are too easy as a test for these students.

As the numerical grades of all these students are recorded, the averages of all the subjects taken by them during their college course (in the case of the high school girls during their high school course) were used as an index of their scholarship and correlated with their Point Scale and Terman averages, giving the following coefficients (r). The figures in parenthesis indicate the number of students in each class.

TABLE IV

| | Sophomores | Juniors-Seniors | Coll. St. | Teachers | Jun. | Sen. | H.S. |
|---|---|---|---|---|---|---|---|
| Point Scale av. & Scholarship | .43(50) | .73(81) | .74(131) | | .33 | .38 | .39 |
| Point Scale av. & Psychology av. | .56 | .69 | .68 | .85(17) | | | |
| Terman XIV–XVIII & Scholarship | .21(48) | .38(92) | .30(140) | | | | |
| Terman XIV–XVIII & Psychology | .13 | .18 | .16 | | | | |
| Terman XVI–XVIII & Scholarship | .30 | .55 | .52 | | | | |
| Terman XVI–XVIII & Psychology | .46 | .65 | .65 | .47(17) | | | |
| Scholarship & Psychology | .48 | .41 | .50 | | | | |
| Point Scale & Terman XIV–XVIII | .37(44) | .36(57) | .39(101) | | | | |
| Point Scale & Terman XVI–XVIII | .37 | .22 | .49 | | .51(118) | | |

The most striking feature about these coefficients is that the averages of the Terman tests give much lower correlation than the Point Scale scores. This holds true also in all my investigations with younger children. The coefficients for the high school classes are low, but the number of pupils, only 39 in all, is too small to give them much significance. It is interesting, however, to note that the coefficients increase with the higher classes, thus showing the effect of the greater maturity and the larger number of courses included in the scholarship average. It is evident that the Terman tests for the years XVI and XVIII give much higher correlation with scholarship than the combined XIV, XVI, and XVIII.year exercises. In the case of psychology, the average of only the first year's courses was used, so that all the classes would be rated on the same work. Again, the Point Scale correlations are higher, tho the coefficients for the Terman Adult tests (XVI-XVIII) are nearly the same as for the Point Scale.

In conclusion, the results of these tests show that the averages of these students for the Adolescent-Adult Point Scale was higher than that obtained by Senior women at Harvard and that the dis-

tribution of the scores resemble more closely that of the Harvard men, except at the lower end. The fact that these students were less mature and that the majority were Sophomores and Juniors will account for some of the low scores. These results also show that some of the tests are of doubtful value in differentiating the more from the less mature and able students. The correlations between mental and educational performance give higher coefficients for the Yerkes-Rossy Adolescent-Adult Point Scale than for the Terman tests for years XIV-XVIII, and also for the years XVI-XVIII, tho in the latter case the difference is not so great.

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## THE GROWTH OF INTELLIGENCE

In connection with some recent investigations on the growth of intelligence, I have been astonished by one fact which is so strikingly substantiated by several sets of data and is of such great importance, if subsequently verified, that I venture to submit it to the readers of the Journal in advance of formal presentation in a technical article.

The investigations of Terman seemed to indicate that 16 years was the upper life age limit in the growth of intelligence of average individuals. New data seem to indicate that this age should be reduced to 13 years. The facts in support of such reduction are as follows:

1. The average mental age of drafted recruits in the U. S. Army by group tests and by mental age equivalents for group test scores as indicated by clinical examinations, proved to be approximately 13 years. This may be taken to mean that mental age growth on the average was complete in these individuals at 13 years of age or thereabouts.

2. The application of the Army Alpha group test to over 500 children in a typical average grammar school of Trenton, N. J., showed increasing median scores up to the age of 13 with no increase thereafter, although a significant number of cases in the ages up to 16 years were examined. This was true for both sexes.

3. The application of the Army Alpha group test to approximately 500 delinquent boys in the State Home for Boys at Jamesburg, N. J., showed increasing medium scores for each age group up to 13 without increasing thereafter, although a sufficient number of cases was available up to 16 years.

4. The study of continuous mental age examinations of feeble-minded from the Training School at Vineland, covering at least four successive annual examinations, indicates that mental age continues to develop in all grades of feeble-mindedness up to the life age limit of 13 years. Out of 250 cases to be studied only 30

have so far been statistically examined, but the conclusion seems legitimate from an inspection of the uncalculated results. If this conclusion be substantiated, then it follows that the point of final arrest in the mental development of the feeble-minded is, after all, not a function of retardation or of mental grade, but is conditioned by life age.

These conclusions are in accord with the very early investigations conducted by Gilbert at Yale about 25 years ago. They are also in accord with the most recent investigation on brain development. I am informed by Dr. S. D. Porteous, Director of Research at the Training School at Vineland, that his extensive investigation of cranial and brain development indicates that at 13 years brain development is practically complete in gross volume although a certain amount of cortical elaboration goes on after that age. This elaboration, in his view, is more the result or basis of intellectual maturity or experience rather than of brain power as such; that is, the development after 13 years may be qualitative rather than quantitative, although, of course, in this case quality also is quantity.

These several lines of investigation agree so consistently in their combined conclusion that I submit it as a new working hypothesis in psychological investigation as applied to education. It is at present only an hypothesis indicated by preliminary investigation and is not in any sense a final conclusion. Its import for educational theory and practice is obvious. It implies that education for the masses is available on an intellectual basis only through the grammar grades. High-school and college work from this point of view is available only for those above the 13-year median intelligence, probably the upper quartile of all ages above 13. If substantiated, this 13-year level will necessitate a revision of all previous work based on intelligence quotients which were calculated on the 16-year basis. It will also revise our concepts in relation to gifted individuals in ages after 13.

Further communication on this topic both theoretical and as a result of experiment is highly desirable. It is to be hoped that this preliminary communication will stimulate reaction in other psychologists.

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# ABSTRACTS AND REVIEWS

ABRAHAM A. ROBACK. *The Interference of Will-Impulses, With Applications to Pedagogy, Ethics, and Practical Efficiency.* Psychological Monographs, Vol. 25, No. 5, Whole Number III, 1918. Pp. 158.

The experimentation of this study consisted in arranging a series of reactions to a series of rapidly presented stimuli. These stimuli were series of red crosses and green dots presented to the subjects in a succession that sometimes began at a relatively slow and increased to a rapid rate and sometimes at a rapid and decreased to a slow rate. Each presentation was in two periods of about three minutes each, separated by a rest interval. The motor responses consisted of all sorts of movements of two telegraph keys with varied combinations between the movements demanded and the crosses and dots that served as stimuli. The general plan was to study the phenomena of interference which occurred when different and somewhat conflicting responses had to be made in rapid succession.

Passing over the experimental data themselves, we may refer to a number of inferences and applications that Mr. Roback enters upon toward the close of his monograph. Among these the following are of interest:

1. In a conflict of two interests, the line of least resistance is followed. If a man chooses, then, to do right, it is because that desire is stronger in him than the desire to do wrong.
2. Of two tasks of unequal difficulty, it is better to begin with the more difficult one if both are relatively easy, but with the less difficult one if both are relatively difficult.
3. Because in the experimental work it was found that after an inhibitory break the situation is usually regained by starting on the easier of the two movements, it is inferred that there should be a review of previous work before a new line of thought is taken up.
4. Mistakes occur as frequently when a task is too easy as when a task is too difficult. A certain moderate amount of difficulty should attend each task.
5. The amount of ease or difficulty experienced in attacking a task depends partly on the attitude with which it is confronted. For instance, a very difficult task may be accomplished with more than ordinary success when the person is 'set' for an artificial task even more exacting.
6. There seem to be differences in motor type which ought to be recognized by teachers in dealing with pupils. In this experiment the subjects fall into two groups—the 'undulators,' who emphasize certain tasks and leave gaps in the performance of others, and the 'equalizers,' who distribute their efforts over all tasks but may fail to complete any of them.

7. When confusion or difficulty appears, the more specific determining tendencies disappear before the more general ones do. For instance, a subject may continue to tap the key when he no longer taps it in the precise manner prescribed. From this it is inferred that the larger general principles received in school instruction will persist when specific details are lost, so that the closest attention and greatest stress should be laid on the more specific aspects of instruction.

8. It may be possible to determine the degree of a person's susceptibility to interference by a series of tests and these determinations might conceivably be significant for industrial efficiency.

These applications are surely interesting. One may be disposed to grant their correctness as educational maxims and yet question whether they can be legitimately inferred from the experiments made by Mr. Roback. They strike one as being examples of 'drawing a long bow.'

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LOUIS C. KARPINSKI. *Origines et Developpement de l'Algebre.* Scientia, Volume 26, pages 89-101.

The historical development of our system of elementary algebra has considerable significance for the student of education. Algebra is not a game, devised by some single individual and foisted off on an unsuspecting world as a subject of instruction for the youth of the land; rather algebra is the almost inevitable product of intelligence (reason) reacting upon the world in which it finds itself.

The ancient Egyptians as early as 2000 B. C. began the study of first degree equations and even types of quadratics, with some algebraic symbolism; they also discussed somewhat intensively arithmetical and geometrical series, powers of numbers, formulas for areas and volumes, and other algebraical notions which are still the subject of instruction. Independently the Babylonian civilization made studies along these various lines, excepting only the equations.

The direction of progress of Greek studies along algebraical lines was determined largely by the preceding Egyptian work, but the Greek treatment of many of these notions was geometrical; the Greek contribution to progress was primarily the rigorously logical procedure.

The Hindu civilization produced similar algebraical material, but emphasized rather algebraical notations and numerical computations.

To the Arabs we are indebted not only for the first systematic treatises on algebra, but also for systematic discussions of the Hindu-Arabic arithmetic which we use, and of trigonometry. The Arabs are by no means simple intermediaries without significant contributions of their own. They combined the logical Greek material

with the numerical and strictly algebraical ideas of the Hindus and they systematized the resultant whole.

The revival of learning in Europe began with the study of Arabic works of science and philosophy. Through translation of Arabic works, the algebra and the new arithmetic were spread broadcast through medieval Europe. The first fruits of this revival are found in Italy, in the solution of the cubic and the biquadratic. The further development continued in France, particularly with Viete, to whom we are indebted for a general literal symbolism, and with Descartes and Fermat (both 17th century) to whom we owe the graphical representation of algebraical equations. Later developments are the products of mathematicians of all the world.

Our elementary instruction in algebra has undoubtedly failed, frequently, to bring out the universality of the appeal and of the application of this subject, but this defect demands not eradication of the algebra but modification of our treatment of it in the school.

Abstract by the AUTHOR.

University of Michigan.

# The Journal of Educational Psychology

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## EDITORIAL

**A DECADE OF EDUCATIONAL PROGRESS**

With the present number the JOURNAL OF EDUCATIONAL PSYCHOLOGY completes its tenth year. The decade has been characterized by intense and diversified activity in the scientific study of education. A brief glance at some of its outstanding features will be in place here. At the beginning of the decade the old "child study" movement had reached its zenith and its methods of "questionnaire" investigation had been severely criticized. It had, however, aroused a widespread popular interest in the study of educational processes, and had contributed in no small degree to the establishment of teaching positions in education in the colleges and universities of the country. Meumann had published his *Vorlesungen zur Einfuehrung in die Experimentelle Paedagogik* in 1907, and through this work and his *Zeitschrift* maintained a dominating position in the scientific study of education throughout the world. There was much talk of the applications of laboratory psychology to education, but the psy-

chology contemplated was of the formal, technical, Wundtian type, and the applications were neither numerous nor helpful. The Binet tests, through Goddards missionary efforts, were beginning to be talked of here and there, Rice and Stone had attacked the problem of arithmetical abilities, Rice and Cornman had made studies in spelling, and Thorndike was gathering materials for his handwriting scale,—the first scale to be offered for measuring attainments in a school subject. At this juncture the JOURNAL OF EDUCATIONAL PSYCHOLOGY was established, as an organ for the publication of educational researches, as a forum for the discussion of problems in educational psychology, and as a mediator between the laboratory investigator and practical school man.

A detailed survey of the activities in the scientific study of education during the decade, and of the part which this JOURNAL has played in them, would take us far beyond our present limits. In the rapidly expanding field of tests of intelligence the studies of Terman on the revision of the Binet scale, the various articles expounding the Yerkes Point Scale, the Otis Group Tests of Intelligence, and the Pressey Primary Tests are some of the more important of the contributions appearing in its columns. In the general subject of learning we have had the studies of Dearborn and others on the effects of practice, and those of Pyle, Lakenan, Lyon, and Myers on memory, and those of Starch, Hollingworth and Poffenberger on correlation and the spread of improvement. Other interesting studies in general educational psychology have been those of Foster, Whipple and Dallenbach on observation, that of Yerkes in advertising, that of Jones in telegraphy, and more recently that of Herring in the measurement of thinking. But it is in the field of the measurement of attainments in school subjects that the most conspicuous service has been rendered. Suffice it to note the articles of Pintner, Starch, Meade, Peters, Whipple, Thorndike, Kelly, and Monroe on reading, those of Winch, Pearson, Cook, Kline, Starch, and Murray on spelling, those of Starch, King and Johnson, Pintner, and Myers and Lister on handwriting, those of Winch, Starch, Brown Phillir, Hahn and Thorndike, Kirkpatrick, and Cobb on arithmetic, of Thorndike on composition, of Rapeer, and Starch on grammar, of Lackey on geography, and of Childs on drawing. Ruediger and Strayer, Witham, and Boyce have proposed scales for the measurement of merit in teachers, Henmon has described valuable Latin scales, Minnick, and Stockard and Bell have discussed tests in geometry, Bell and McCollum have reported tests in United States history, Sackett has presented a scale in ancient history, and Bell has given the results of a test in chemistry. It will be seen, therefore, that in every field of educational measurement the JOURNAL has taken a prominent part, and has contributed no small share to that vigorous development of the scientific study of education which has been the chief characteristic of the decade, and which promises to put America in the forefront of educational progress throughout the world.

J. C. BELL

# NOTES AND NEWS

The November meeting of the New York Society for the Experimental Study of Education was devoted to the topic of "Problems in the Teaching of Secondary Mathematics." The chief speakers were Dr. J. H. Minnick, of the University of Pennsylvania, on "Mathematical Tests," and Dr. Truman Lee Kelley, of Teachers College, on "Purposes of High School Mathematics." Dr. Minnick made a critical survey of the various tests in algebra and geometry, and discussed their value for diagnosis, prognosis, and measurement of mathematical attainment. More extended experimentation is called for in working out new tests for specific ends, comparing present tests for their usefulness in school work, and evaluating the results from the point of view of the class-room teacher. Dr. Kelley gave a digest of an investigation to determine the values of high school mathematics in the estimation of prominent business and professional men and women. On the basis of the findings an experiment was arranged to teach first year high school mathematics as an inspirational and cultural subject to one class, while a parallel class was taught traditional algebra. Standard tests were used at the beginning and at the end of the experiment. The experimental class showed a keener interest and a broader grasp, while the control class was superior in the drill aspects of mathematics.

The New York Branch of the American Psychological Association met on Monday, November 24, with the following program: "Emotional Instability of Children," Miss Buford Johnson; "A Criticism of MacDougall's Doctrine of Interests," Mr. Alfred H. Martin; "A Study of Race Difference in Intelligence," Miss Katherine Murdock; "The Relation between Intellectuality and Morality," Miss Clara F. Chassell.

Dr. J. E. W. Wallin, who has been chairman of the Committee on Defective Children for the Missouri Children's Code Commission during the last four years, has been appointed chairman of the Committee on Mental Defectiveness for the Missouri Conference for Social Welfare, and elected president of the Department of Special Classes of the Missouri State Teachers Association.

Dr. T. R. Garth, of the department of psychology in the West Texas State Normal College, has been appointed adjunct professor of psychology at the University of Texas.

Lieutenant-Colonel C. S. Myers, university lecturer and director of the university laboratory of experimental psychology, Cambridge, England, has been elected to a fellowship in Gonville and Caius College, Cambridge.

Dr. Edward G. Boring, of Cornell University, has been appointed professor of experimental psychology and head of the psychological laboratory at Clark University to succeed the late Professor Baird.

Dr. J. E. Dashiell, assistant professor of psychology in Oberlin College, has been appointed associate professor in charge of psychology in the University of North Carolina, succeeding in that capacity the president elect, Dr. H. W. Chase.

Dr. A. E. Davies, professor of philosophy in Ohio State University, has been appointed professor of philosophy and psychology in Colorado College.

Mr. Homer W. Anderson has been appointed to a position in the department of research of the Detroit city schools.

Mr. David A. Grove has been appointed professor of psychology and education at the Western College for Women, Osford, Ohio.

Dr. Chester A. Buckner, for the past two years in charge of educational measurements in The Lincoln School, Teachers College, has been appointed professor of education in the University of Kansas, where he will be the director of the Bureau of School Service.

Dr. John M. Brewers, head of the department of education of the Southern Branch of the University of California, has accepted the position of director of the Harvard Bureau of Vocational Guidance.

Dr. Rutledge T. Wiltbank, of the University of Washingron, has been appointed assistant professor of psychology in the University of Chicago.

Dr. Walter R. Ames has been appointed assistant professor of education and psychology in the University of Montana.

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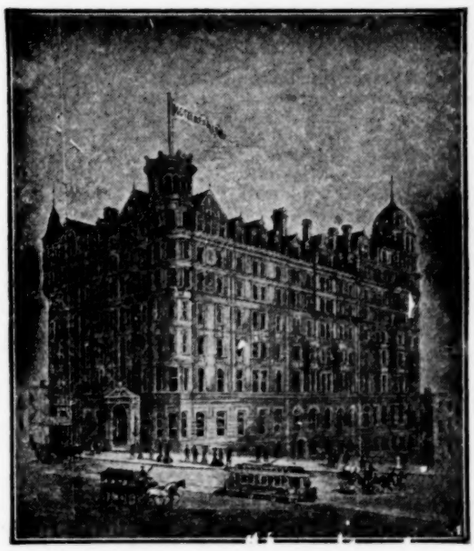

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W. H. FLETCHER, State Normal School, Oshkosh, Wisconsin. *A "Translation" Method of Teaching Latin.*

An account of a method of teaching Latin which is based on the same procedures as those employed in teaching first grade pupils to read English. The emphasis is placed on the recognition of words in their relations as used to express ideas. Grammar, diction and translation are stressed, and only such grammatical constructions are noted as are essential to the comprehension of the passage.

GEORGE W. FRASER, Director of Research, State Normal School, Cheney, Washington. *An Inquiry into the Statistical Basis of a Conclusion Concerning Sex Differences.*

Yerkes, in his monograph on the Point Scale, presents evidence of marked sex differences between boys and girls at the age of ten years. The author critically examines Yerkes' data, rearranges the array of scores, and shows that with one arrangement the difference is very much reduced, and with another it is eliminated altogether.


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